YAMAHA SINGLE-AXIS ROBOT

FLIP-XC Series

Installation Manual

Clean type

C4L/C4LH/C5L/C5LH/C6L
C8/C8L/C8LH
C10/C14/C14H/C17/C17L/C20

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Ver. 1.01

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Before using the single-axis robot FLIP-XC series (Be sure to read the following notes.) i

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1. Safety Information

Industrial robots are highly programmable, mechanical devices that provide a large degree of freedom when performing various manipulative tasks. To ensure safe and correct use of YAMAHA industrial robots and controllers, carefully read and comply with the safety instructions and precautions in this "Safety Instructions" guide. Failure to take necessary safety measures or incorrect handling may result in trouble or damage to the robot and controller, and also may cause personal injury (to installation personnel, robot operator or service personnel) including fatal accidents.

Before using this product, read this manual and related manuals and take safety precautions to ensure correct handling.
The precautions listed in this manual relate to this product. To ensure safety of the user's final system that includes YAMAHA robots, please take appropriate safety measures as required by the user's individual system.

To use YAMAHA robots and controllers safely and correctly, always comply with the safety rules and instructions.

- For specific safety information and standards, refer to the applicable local regulations and comply with the instructions.
- This manual and warning labels supplied with or attached to the robot are written in English. Unless the robot operators or service personnel understand English, do not permit them to handle the robot.
- Cautions regarding the official language of EU countries
  For equipment that will be installed in EU countries, the language used for the manuals, warning labels, operation screen characters, and CE declarations is English only.
  Warning labels only have pictograms or else include warning messages in English. In the latter case, messages in Japanese or other languages might be added.

It is not possible to list all safety items in detail within the limited space of this manual. So please note that it is essential that the user have a full knowledge of safety and also make correct judgments on safety procedures.

Refer to the manual by any of the following methods when installing, operating or adjusting the robot and controller.

1. Install, operate or adjust the robot and controller while referring to the printed version of the manual (available for an additional fee).
2. Install, operate or adjust the robot and controller while viewing the CD-ROM version of the manual on your computer screen.
3. Install, operate or adjust the robot and controller while referring to a printout of the necessary pages from the CD-ROM version of the manual.

2. Signal words used in this manual

This manual uses the following safety alert symbols and signal words to provide safety instructions that must be observed and to describe handling precautions, prohibited actions, and compulsory actions. Make sure you understand the meaning of each symbol and signal word and then read this manual.

DANGER

THIS INDICATES AN IMMEDIATELY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.

WARNING

THIS INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.

CAUTION

This indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or damage to the equipment.

NOTE

Explains the key point in the operation in a simple and clear manner.

3. Warning labels

Warning labels shown below are attached to the robot body and controller to alert the operator to potential hazards. To ensure correct use, read the warning labels and comply with the instructions.

3.1 Warning labels

WARNING

IF WARNING LABELS ARE REMOVED OR DIFFICULT TO SEE, THEN THE NECESSARY PRECAUTIONS MAY NOT BE TAKEN, RESULTING IN AN ACIDENT.

- **DO NOT REMOVE, ALTER OR STAIN THE WARNING LABELS ON THE ROBOT BODY.**
- **DO NOT ALLOW WARNING LABELS TO BE HIDDEN BY DEVICES INSTALLED ON THE ROBOT BY THE USER.**
- **PROVIDE PROPER LIGHTING SO THAT THE SYMBOLS AND INSTRUCTIONS ON THE WARNING LABELS CAN BE CLEARLY SEEN FROM OUTSIDE THE SAFETY ENCLOSURE.**

3.1.1 Warning label messages

Word messages on the danger, warning and caution labels are concise and brief instructions. For more specific instructions, read and follow the "Instructions on this label" described on the right of each label shown below.

1. Warning label 1 (SCARA robots, Cartesian robots)

DANGER

SERIOUS INJURY MAY RESULT FROM CONTACT WITH A MOVING ROBOT.

- **KEEP OUTSIDE OF THE ROBOT SAFETY ENCLOSURE DURING OPERATION.**
- **PRESS THE EMERGENCY STOP BUTTON BEFORE ENTERING THE SAFETY ENCLOSURE.**

Instructions on this label
• Always install a safety enclosure to keep all persons away from the robot movement range and prevent injury from contacting the moving part of the robot. • Install an interlock that triggers emergency stop when the door or gate of the safety enclosure is opened. • The safety enclosure should be designed so that no one can enter inside except from the door or gate equipped with an interlock device. • Warning label 1 that comes supplied with a robot should be affixed to an easy-to-see location on the door or gate of the safety enclosure.

90K41-001470

2. Warning label 2 (SCARA robots, Cartesian robots, single-axis robots*)

* Warning label 2 is not attached to some small single-axis robots, but is supplied with the robots.

WARNING

MOVING PARTS CAN PINCH OR CRUSH HANDS.
KEEP HANDS AWAY FROM THE MOVABLE PARTS OF THE ROBOT.

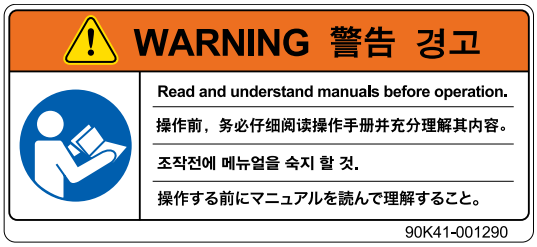
Instructions on this label
Use caution to prevent hands and fingers from being pinched or crushed by the movable parts of the robot when transporting or moving the robot or during teaching.

90K41-001460

3. Warning label 3 (SCARA robots, Cartesian robots)

WARNING

IMPROPER INSTALLATION OR OPERATION MAY CAUSE SERIOUS INJURY.
BEFORE INSTALLING OR OPERATING THE ROBOT, READ THE MANUAL AND INSTRUCTIONS ON THE WARNING LABELS AND UNDERSTAND THE CONTENTS.



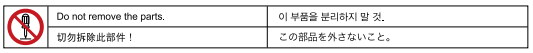
Instructions on this label
• Be sure to read the warning label and this manual carefully to make you completely understand the contents before attempting installation and operation of the robot. • Before starting the robot operation, even after you have read through this manual, read again the corresponding procedures and "Safety instructions" in this manual. • Never install, adjust, inspect or service the robot in any manner that does not comply with the instructions in this manual.

90K41-001290

4. Warning label 4 (SCARA robots)

CAUTION

Do not remove the parts on which Warning label 4 is attached.
Doing so may damage the ball screw.



Instructions on this label
The Z-axis ball screw will be damaged if the upper end mechanical stopper on the Z-axis spline is removed or moved. Never attempt to remove or move it.

90K41-001520

5. "Read instruction manual" label (Controller)*

CAUTION

Refer to the manual.

Instructions on this label
This indicates important information that you must know and is described in the manual. Before using the controller, be sure to read the manual thoroughly. When adding external safety circuits or connecting a power supply to the controller, read the manual carefully and make checks before beginning the work. Connectors must be attached while facing a certain direction, so insert each connector in the correct direction.

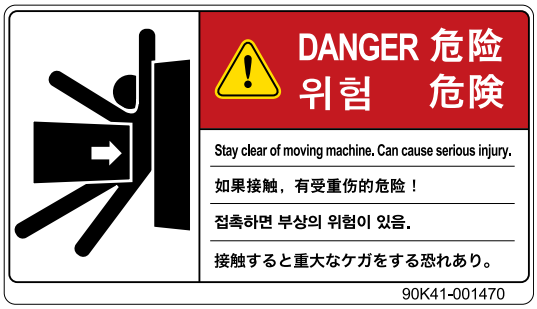
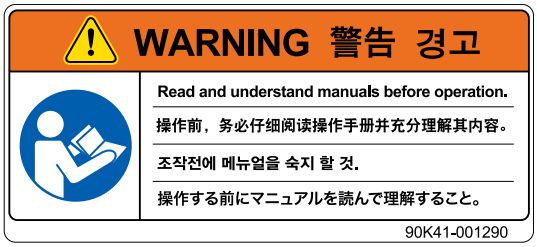
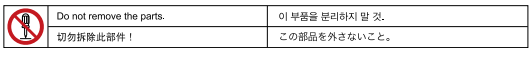
93005-X0-00

* This label is attached near the power input connector on the front panel.

3.1.2 Supplied warning labels

Some warning labels are not affixed to robots but included in the packing box. **These warning labels should be affixed to an easy-to-see location.**

● Warning label is attached to the robot body.
○ Warning label comes supplied with the robot and should be affixed to an easy-to-see location on the door or gate of the safety enclosure.
◎ Warning label comes supplied with the robot and should be affixed to an easy-to-see location.

		SCARA robots	Cartesian robots	Single-axis robots
Warning label 1		●*1 ○	● ○	 ○
Warning label 2		●*1	●	●*2
Warning label 3		●*1	●	◎
Warning label 4		●*1		

*1: For the label positions, see the SCARA robot user's manual ("1.2 Part names" in Chapter 1).
*2: This label is not attached to some small single-axis robots, but is supplied with the robots.

3.2 Warning symbols

Warning symbols shown below are printed on the robot and controller to alert the operator to potential hazards. To use the YAMAHA robot safely and correctly always follow the instructions and cautions indicated by the symbols.

1. Electrical shock hazard symbol

WARNING

TOUCHING THE TERMINAL BLOCK OR CONNECTOR MAY CAUSE ELECTRICAL SHOCK, SO USE CAUTION.

	Instructions by this symbol
	This indicates a high voltage is present. Touching the terminal block or connector may cause electrical shock.

93006-X0-00

2. High temperature hazard symbol

WARNING

MOTORS, HEATSINKS, AND REGENERATIVE UNITS BECOME HOT, SO DO NOT TOUCH THEM.

	Instructions by this symbol
	This indicates the area around this symbol may become very hot. Motors, heatsinks, and regenerative units become hot during and shortly after operation. To avoid burns be careful not to touch those sections.

93008-X0-00

3. Caution symbol

CAUTION

Always read the manual carefully before using the controller.

	Instructions by this symbol
	This indicates important information that you must know and is described in the manual. Before using the controller, be sure to read the manual thoroughly. When adding external safety circuits or connecting a power supply to the controller, read the manual carefully and make checks before beginning the work. Connectors must be attached while facing a certain direction, so insert each connector in the correct direction.

93007-X0-00

4. Major precautions for each stage of use

This section describes major precautions that must be observed when using robots and controllers. Be sure to carefully read and comply with all of these precautions even if there is no alert symbol shown.

4.1 Precautions for using robots and controllers

General precautions for using robots and controllers are described below.

1. Applications where robots cannot be used

YAMAHA robots and robot controllers are designed as general-purpose industrial equipment and cannot be used for the following applications.

DANGER

YAMAHA ROBOT CONTROLLERS AND ROBOTS ARE DESIGNED AS GENERAL-PURPOSE INDUSTRIAL EQUIPMENT AND CANNOT BE USED FOR THE FOLLOWING APPLICATIONS.

- **IN MEDICAL EQUIPMENT SYSTEMS WHICH ARE CRITICAL TO HUMAN LIFE**
- **IN SYSTEMS THAT SIGNIFICANTLY AFFECT SOCIETY AND THE GENERAL PUBLIC**
- **IN EQUIPMENT INTENDED TO CARRY OR TRANSPORT PEOPLE**
- **IN ENVIRONMENTS WHICH ARE SUBJECT TO VIBRATION SUCH AS ONBOARD SHIPS AND VEHICLES.**

2. Qualification of operators/workers

Operators or persons who handle the robot such as for teaching, programming, movement check, inspection, adjustment, and repair must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must read the manual carefully to understand its contents before attempting the robot operation or maintenance.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and standards for industrial robots.

WARNING

- **THE ROBOT MUST BE OPERATED ONLY BY PERSONS WHO HAVE RECEIVED SAFETY AND OPERATION TRAINING. OPERATION BY AN UNTRAINED PERSON IS EXTREMELY HAZARDOUS.**
- **ADJUSTMENT AND MAINTENANCE BY REMOVING A COVER REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS, AND MAY ALSO INVOLVE HAZARDS IF ATTEMPTED BY AN UNSKILLED PERSON. THESE TASKS MUST BE PERFORMED ONLY BY PERSONS WHO HAVE ENOUGH ABILITY AND QUALIFICATIONS IN ACCORDANCE WITH LOCAL LAWS AND REGULATIONS. FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.**

4.2 Design

4.2.1 Precautions for robots

1. Provide safety measures for end effector (gripper, etc.)

WARNING

- END EFFECTORS MUST BE DESIGNED AND MANUFACTURED SO THAT THEY CAUSE NO HAZARDS (SUCH AS A LOOSE WORKPIECE OR LOAD) EVEN IF POWER (ELECTRICITY, AIR PRESSURE, ETC.) IS SHUT OFF OR POWER FLUCTUATIONS OCCUR.
- IF THE OBJECT GRIPPED BY THE END EFFECTOR MIGHT POSSIBLY FLY OFF OR DROP, THEN PROVIDE APPROPRIATE SAFETY PROTECTION TAKING INTO ACCOUNT THE OBJECT SIZE, WEIGHT, TEMPERATURE, AND CHEMICAL PROPERTIES.

2. Provide adequate lighting

Provide enough lighting to ensure safety during work.

3. Install an operation status light

WARNING

INSTALL A SIGNAL LIGHT (SIGNAL TOWER) AT AN EASY-TO-SEE POSITION SO THAT THE OPERATOR WILL BE AWARE OF THE ROBOT STOP STATUS (TEMPORARILY STOPPED, EMERGENCY STOP, ERROR STOP, ETC.).

4. Do not use robots for tasks requiring motor thrust

CAUTION

Avoid using the belt-driven robots for tasks which make use of motor thrust (press-fitting, burr removal, etc.). These tasks may cause the robot to malfunction.

5. Clean work tools

Work tools such as welding guns and paint nozzles mounted on the robot manipulator tip should preferably be cleaned automatically when needed.

4.2.2 Precautions for robot controllers

1. Emergency stop input terminal

DANGER

EACH ROBOT CONTROLLER HAS AN EMERGENCY STOP INPUT TERMINAL TO TRIGGER EMERGENCY STOP. USING THIS TERMINAL, INSTALL A SAFETY CIRCUIT SO THAT THE SYSTEM INCLUDING THE ROBOT CONTROLLER WILL WORK SAFELY.

2. Maintain clearance

CAUTION

Do not bundle control lines or communication cables together or in close to the main power supply or power lines. Usually separate these by at least 100mm. Failure to follow this instruction may cause malfunction due to noise.

4.3 Moving and installation

4.3.1 Precautions for robots

■ Installation environment

1. Do not use in strong magnetic fields

WARNING

DO NOT USE THE ROBOT NEAR EQUIPMENT OR IN LOCATIONS THAT GENERATE STRONG MAGNETIC FIELDS. THE ROBOT MAY BREAKDOWN OR MALFUNCTION IF USED IN SUCH LOCATIONS.

2. Do not use in locations subject to possible electromagnetic interference, etc.

WARNING

DO NOT USE THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. THE ROBOT MAY MALFUNCTION IF USED IN SUCH LOCATIONS CREATING HAZARDOUS SITUATIONS.

3. Do not use in locations exposed to flammable gases

WARNING

- YAMAHA ROBOTS ARE NOT DESIGNED TO BE EXPLOSION-PROOF.
- DO NOT USE THE ROBOTS IN LOCATIONS EXPOSED TO EXPLOSIVE OR INFLAMMABLE GASES, DUST PARTICLES OR LIQUID. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH, OR LEAD TO FIRE.

■ Moving

1. Use caution to prevent pinching or crushing of hands or fingers

WARNING

MOVING PARTS CAN PINCH OR CRUSH HANDS OR FINGERS.
KEEP HANDS AWAY FROM THE MOVABLE PARTS OF THE ROBOT.

As instructed in Warning label 2, use caution to prevent hands or fingers from being pinched or crushed by movable parts when transporting or moving the robot. For details on warning labels, see "3. Warning labels" in "Safety instructions."

2. Take safety measures when moving the robot

To ensure safety when moving a SCARA robot with an arm length of 500mm or more, use the eyebolts that come supplied with the robot.
Refer to the robot manual for details.

■ Installation

1. Protect electrical wiring and hydraulic/pneumatic hoses

Install a cover or similar item to protect the electrical wiring and hydraulic/pneumatic hoses from possible damage.

■ Wiring

1. Protective measures against electrical shock

WARNING

ALWAYS GROUND THE ROBOT TO PREVENT ELECTRICAL SHOCK.

■ Adjustment

1. Adjustment that requires removing a cover

WARNING

YAMAHA ROBOT CONTROLLERS ARE NOT DESIGNED TO BE EXPLOSION-PROOF. DO NOT USE THEM IN LOCATIONS EXPOSED TO EXPLOSIVE OR INFLAMMABLE GASES, GASOLINE OR SOLVENT. FAI LURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH, OR LEAD TO FIRE. FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.

4.3.2 Precautions for robot controllers

■ Installation environment

1. Installation environment

WARNING

YAMAHA ROBOTS AND ROBOT CONTROLLERS ARE NOT DESIGNED TO BE EXPLOSION-PROOF. DO NOT USE THEM IN LOCATIONS EXPOSED TO EXPLOSIVE OR INFLAMMABLE GASES, GASOLINE OR SOLVENT. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH, AND LEAD TO FIRE.

WARNING

- USE THE ROBOT CONTROLLER IN LOCATIONS THAT SUPPORT THE ENVIRONMENTAL CONDITIONS SPECIFIED IN THIS MANUAL. OPERATION OUTSIDE THE SPECIFIED ENVIRONMENTAL RANGE MAY CAUSE ELECTRICAL SHOCK, FIRE, MALFUNCTION OR PRODUCT DAMAGE OR DETERIORATION.
- THE ROBOT CONTROLLER AND PROGRAMMING BOX SHOULD BE INSTALLED AT A LOCATION THAT IS OUTSIDE THE ROBOT MOVEMENT RANGE YET WHERE IT IS EASY TO OPERATE AND VIEW ROBOT MOVEMENT.
- INSTALL THE ROBOT CONTROLLER IN LOCATIONS WITH ENOUGH SPACE TO PERFORM WORK (TEACHING, INSPECTION, ETC.) SAFELY. LIMITED SPACE NOT ONLY MAKES IT DIFFICULT TO PERFORM WORK BUT CAN ALSO CAUSE INJURY.
- INSTALL THE ROBOT CONTROLLER IN A STABLE, LEVEL LOCATION AND SECURE IT FIRMLY. AVOID INSTALLING THE CONTROLLER UPSIDE DOWN OR IN A TILTED POSITION.
- PROVIDE SUFFICIENT CLEARANCE AROUND THE ROBOT CONTROLLER FOR GOOD VENTILATION. INSUFFICIENT CLEARANCE MAY CAUSE MALFUNCTION, BREAKDOWN OR FIRE.

■ Installation

To install the robot controller, observe the installation conditions and method described in the manual.

1. Installation

WARNING

SECURELY TIGHTEN THE SCREWS FOR THE L-SHAPED BRACKETS USED TO INSTALL THE ROBOT CONTROLLER. IF NOT SECURELY TIGHTENED, THE SCREWS MAY COME LOOSE CAUSING THE CONTROLLER TO DROP.

2. Connections

WARNING

- ALWAYS SHUT OFF ALL PHASES OF THE POWER SUPPLY EXTERNALLY BEFORE STARTING INSTALLATION OR WIRING WORK. FAILURE TO DO THIS MAY CAUSE ELECTRICAL SHOCK OR PRODUCT DAMAGE.
- NEVER DIRECTLY TOUCH CONDUCTIVE SECTIONS AND ELECTRONIC PARTS OTHER THAN THE CONNECTORS, ROTARY SWITCHES, AND DIP SWITCHES ON THE OUTSIDE PANEL OF THE ROBOT CONTROLLER. TOUCHING THEM MAY CAUSE ELECTRICAL SHOCK OR BREAKDOWN.
- SECURELY INSTALL EACH CABLE CONNECTOR INTO THE RECEPTACLES OR SOCKETS. POOR CONNECTIONS MAY CAUSE THE CONTROLLER OR ROBOT TO MALFUNCTION.

■ Wiring

1. Connection to robot controller

The controller parameters are preset at the factory before shipping to match the robot model. Check the specified robot and controller combination, and connect them in the correct combination.
Since the software detects abnormal operation such as motor overloads, the controller parameters must be set correctly to match the motor type used in the robot connected to the controller.

2. Wiring safety points

WARNING

ALWAYS SHUT OFF ALL PHASES OF THE POWER SUPPLY EXTERNALLY BEFORE STARTING INSTALLATION OR WIRING WORK. FAILURE TO DO THIS MAY CAUSE ELECTRICAL SHOCK OR PRODUCT DAMAGE.

CAUTION

- Make sure that no foreign matter such as cutting chips or wire scraps get into the robot controller. Malfunction, breakdown or fire may result if these penetrate inside.
- Do not apply excessive impacts or loads to the connectors when making cable connections. This might bend the connector pins or damage the internal PC board.
- When using ferrite cores for noise elimination, be sure to fit them onto the power cable as close to the robot controller and/or the robot as possible, to prevent malfunction caused by noise.

3. Wiring method

WARNING

SECURELY INSTALL THE CONNECTORS INTO THE ROBOT CONTROLLER AND, WHEN WIRING THE CONNECTORS, MAKE THE CRIMP, PRESS-CONTACT OR SOLDER CONNECTIONS CORRECTLY USING THE TOOL SPECIFIED BY THE CONNECTOR MANUFACTURER.

CAUTION

When disconnecting the cable from the robot controller, detach by gripping the connector itself and not by tugging on the cable. Loosen the screws on the connector (if fastened with the screws), and then disconnect the cable. Trying to detach by pulling on the cable itself may damage the connector or cables, and poor cable contact will cause the controller or robot to malfunction.

4. Precautions for cable routing and installation

CAUTION

- Always store the cables connected to the robot controller in a conduit or clamp them securely in place. If the cables are not stored in a conduit or properly clamped, excessive play or movement or mistakenly pulling on the cable may damage the connector or cables, and poor cable contact will cause the controller or robot to malfunction.
- Do not modify the cables and do not place any heavy objects on them. Handle them carefully to avoid damage. Damaged cables may cause malfunction or electrical shock.
- If the cables connected to the robot controller may possibly become damaged, then protect them with a cover, etc.
- Check that the control lines and communication cables are routed at a gap sufficiently away from main power supply circuits and power lines, etc. Bundling them together with power lines or close to power lines may cause faulty operation due to noise.

5. Protective measures against electrical shock

WARNING

BE SURE TO GROUND THE CONTROLLER USING THE GROUND TERMINAL ON THE POWER TERMINAL BLOCK. POOR GROUNDING MAY CAUSE ELECTRICAL SHOCK.

4.4 Safety measures

4.4.1 Safety measures

1. Referring to warning labels and manual

WARNING

- **BEFORE STARTING INSTALLATION OR OPERATION OF THE ROBOT, BE SURE TO READ THE WARNING LABELS AND THIS MANUAL, AND COMPLY WITH THE INSTRUCTIONS.**
- **NEVER ATTEMPT ANY WORK OR OPERATION UNLESS DESCRIBED IN THIS MANUAL.**
- **NEVER ATTEMPT ANY REPAIR, PARTS REPLACEMENT AND MODIFICATION UNLESS DESCRIBED IN THIS MANUAL. THESE TASKS REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS AND MAY ALSO INVOLVE HAZARDS. PLEASE CONTACT YOUR DISTRIBUTOR FOR ADVICE.**

NOTE

For details on warning labels, see "3. Warning labels" in "Safety instructions."

2. Draw up "work instructions" and make the operators/workers understand them

WARNING

DECIDE ON "WORK INSTRUCTIONS" IN CASES WHERE PERSONNEL MUST WORK WITHIN THE ROBOT MOVEMENT RANGE TO PERFORM STARTUP OR MAINTENANCE WORK. MAKE SURE THE WORKERS COMPLETELY UNDERSTAND THESE "WORK INSTRUCTIONS".

Decide on "work instructions" for the following items in cases where personnel must work within the robot movement range to perform teaching, maintenance or inspection tasks. Make sure the workers completely understand these "work instructions".

1. Robot operating procedures needed for tasks such as startup procedures and handling switches
2. Robot speeds used during tasks such as teaching
3. Methods for workers to signal each other when two or more workers perform tasks
4. Steps that the worker should take when a problem or emergency occurs
5. Steps to take after the robot has come to a stop when the emergency stop device was triggered, including checks for cancelling the problem or error state and safety checks in order to restart the robot.
6. In cases other than above, the following actions should be taken as needed to prevent hazardous situations due to sudden or unexpected robot operation or faulty robot operation as listed below.
   - Place a display sign on the operator panel
   - Ensure the safety of workers performing tasks within the robot movement range
   - Clearly specify position and posture during work
     Specify a position and posture where worker can constantly check robot movements and immediately move to avoid trouble if an error/problem occurs
   - Take noise prevention measures
   - Use methods for signaling operators of related equipment
   - Use methods to decide that an error has occurred and identify the type of error

Implement the "work instructions" according to the type of robot, installation location, and type of work task.
When drawing up the "work instructions" make an effort to include opinions from the workers involved, equipment manufacturer technicians, and workplace safety consultants, etc.

3. Take safety measures

DANGER

- **NEVER ENTER THE ROBOT MOVEMENT RANGE WHILE THE ROBOT IS OPERATING OR THE MAIN POWER IS TURNED ON. FAILURE TO FOLLOW THIS WARNING MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH. INSTALL A SAFETY ENCLOSURE OR A GATE INTERLOCK WITH AN AREA SENSOR TO KEEP ALL PERSONS AWAY FROM THE ROBOT MOVEMENT RANGE.**
- **WHEN IT IS NECESSARY TO OPERATE THE ROBOT WHILE YOU ARE WITHIN THE ROBOT MOVEMENT RANGE SUCH AS FOR TEACHING OR MAINTENANCE/INSPECTION TASKS, ALWAYS CARRY THE PROGRAMMING BOX WITH YOU SO THAT YOU CAN IMMEDIATELY STOP THE ROBOT OPERATION IN CASE OF AN ABNORMAL OR HAZARDOUS CONDITION. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH.**

WARNING

- DURING STARTUP OR MAINTENANCE TASKS, DISPLAY A SIGN "WORK IN PROGRESS" ON THE PROGRAMMING BOX AND OPERATION PANEL IN ORDER TO PREVENT ANYONE OTHER THAN THE PERSON FOR THAT TASK FROM MISTAKENLY OPERATING THE START OR SELECTOR SWITCH. IF NEEDED, TAKE OTHER MEASURES SUCH AS LOCKING THE COVER ON THE OPERATION PANEL.
- ALWAYS CONNECT THE ROBOT AND ROBOT CONTROLLER IN THE CORRECT COMBINATION. USING THEM IN AN INCORRECT COMBINATION MAY CAUSE FIRE OR BREAKDOWN.

4. Install system safeguards

When configuring an automated system using a robot, hazardous situations are more likely to occur from the automated system than the robot itself. So the system manufacturer should install the necessary safety measures required for the individual system. The system manufacturer should provide a proper manual for safe, correct operation and servicing of the system.

WARNING

TO CHECK THE ROBOT CONTROLLER OPERATING STATUS, REFER TO THIS MANUAL AND TO RELATED MANUALS. DESIGN AND INSTALL THE SYSTEM INCLUDING THE ROBOT CONTROLLER SO THAT IT WILL ALWAYS WORK SAFELY.

5. Precautions for operation

WARNING

- DO NOT TOUCH ANY ELECTRICAL TERMINAL. DIRECTLY TOUCHING THESE TERMINALS MAY CAUSE ELECTRICAL SHOCK, EQUIPMENT DAMAGE, AND MALFUNCTION.
- DO NOT TOUCH OR OPERATE THE ROBOT CONTROLLER OR PROGRAMMING BOX WITH WET HANDS. TOUCHING OR OPERATING THEM WITH WET HANDS MAY RESULT IN ELECTRICAL SHOCK OR BREAKDOWN.

6. Do not disassemble and modify

WARNING

NEVER DISASSEMBLE AND MODIFY ANY PART IN THE ROBOT, CONTROLLER, AND PROGRAMMING BOX. DO NOT OPEN ANY COVER. DOING SO MAY CAUSE ELECTRICAL SHOCK, BREAKDOWN, MALFUNCTION, INJURY, OR FIRE.

4.4.2 Installing a safety enclosure

Be sure to install a safety enclosure to keep anyone from entering within the movement range of the robot. The safety enclosure will prevent the operator and other persons from coming in contact with moving parts of the robot and suffering injury.

DANGER

SERIOUS INJURY MAY RESULT FROM CONTACT WITH A MOVING ROBOT.

- KEEP OUTSIDE OF THE ROBOT SAFETY ENCLOSURE DURING OPERATION.
- PRESS THE EMERGENCY STOP BUTTON BEFORE ENTERING THE SAFETY ENCLOSURE.

WARNING

- INSTALL AN INTERLOCK THAT TRIGGERS EMERGENCY STOP WHEN THE DOOR OR GATE OF THE SAFETY ENCLOSURE IS OPENED.
- THE SAFETY ENCLOSURE SHOULD BE DESIGNED SO THAT NO ONE CAN ENTER INSIDE EXCEPT FROM THE DOOR OR GATE EQUIPPED WITH AN INTERLOCK DEVICE.
- WARNING LABEL 1 (SEE "3. WARNING LABELS" IN "SAFETY INSTRUCTIONS") THAT COMES SUPPLIED WITH A ROBOT SHOULD BE AFFIXED TO AN EASY-TO-SEE LOCATION ON THE DOOR OR GATE OF THE SAFETY ENCLOSURE.

4.5 Operation

When operating a robot, ignoring safety measures and checks may lead to serious accidents. Always take the following safety measures and checks to ensure safe operation.

DANGER

CHECK THE FOLLOWING POINTS BEFORE STARTING ROBOT OPERATION.

- **NO ONE IS WITHIN THE ROBOT MOVEMENT RANGE.**
- **THE PROGRAMMING UNIT IS IN THE SPECIFIED LOCATION.**
- **THE ROBOT AND PERIPHERAL EQUIPMENT ARE IN GOOD CONDITION.**

4.5.1 Trial operation

After installing, adjusting, inspecting, maintaining or repairing the robot, perform trial operation using the following procedures.

1. If a safety enclosure has not yet been provided right after installing the robot:

then rope off or chain off the movement range around the robot in place of the safety enclosure and observe the following points.

DANGER

PLACE A "ROBOT IS MOVING - KEEP AWAY!" SIGN TO KEEP THE OPERATOR OR OTHER PERSONNEL FROM ENTERING WITHIN THE MOVEMENT RANGE OF THE ROBOT.

WARNING

- **USE STURDY, STABLE POSTS WHICH WILL NOT FALL OVER EASILY.**
- **THE ROPE OR CHAIN SHOULD BE EASILY VISIBLE TO EVERYONE AROUND THE ROBOT.**

2. Check the following points before turning on the controller.

- Is the robot securely and correctly installed?
- Are the electrical connections to the robot wired correctly?
- Are items such as air pressure correctly supplied?
- Is the robot correctly connected to peripheral equipment?
- Have safety measures (safety enclosure, etc.) been taken?
- Does the installation environment meet the specified standards?

3. After the controller is turned on, check the following points from outside the safety enclosure.

- Does the robot start, stop and enter the selected operation mode as intended?
- Does each axis move as intended within the soft limits?
- Does the end effector move as intended?
- Are the correct signals being sent to the end effector and peripheral equipment?
- Does emergency stop function?
- Are teaching and playback functions normal?
- Are the safety enclosure and interlocks functioning as intended?

4. Working inside safety enclosures

Before starting work within the safety enclosure, **always first confirm from outside the enclosure that each safety function is operating correctly (see the previous section 2.3)**.

DANGER

NEVER ENTER WITHIN THE MOVEMENT RANGE WHILE WITHIN THE SAFETY ENCLOSURE.

WARNING

WHEN WORK IS REQUIRED WITHIN THE SAFETY ENCLOSURE, PLACE A SIGN "WORK IN PROGRESS" IN ORDER TO KEEP OTHER PERSONS FROM OPERATING THE CONTROLLER SWITCH OR OPERATION PANEL.

WARNING

WHEN WORK WITHIN THE SAFETY ENCLOSURE IS REQUIRED, ALWAYS TURN OFF THE CONTROLLER POWER EXCEPT FOR THE FOLLOWING CASES:

Exception

Work with power turned on, but robot in emergency stop

Origin position setting	**SCARA robots**	Follow the precautions and procedure described in "2. Adjusting the origin position" in Chapter 3.
Reference coordinate setting	**SCARA robots**	Follow the precautions and procedure described in "4. Setting the reference coordinates" in Chapter 3.
Soft limit settings	**SCARA robots**	Follow the precautions and procedure described in "3. Setting the soft limits" in Chapter 3.
	Cartesian robots **Single-axis robots**	Follow the precautions and procedure described in "Soft limit" in each controller manual.

Work with power turned on

Teaching	**SCARA robots** **Cartesian robots** **Single-axis robots**	Refer to "5. Teaching within safety enclosure" described below.

5. Teaching within the safety enclosure

When performing teaching within the safety enclosure, check or perform the following points **from outside the safety enclosure**.

DANGER

NEVER ENTER WITHIN THE MOVEMENT RANGE WHILE WITHIN THE SAFETY ENCLOSURE.

WARNING

- MAKE A VISUAL CHECK TO ENSURE THAT NO HAZARDS ARE PRESENT WITHIN THE SAFETY ENCLOSURE.
- CHECK THAT THE PROGRAMMING BOX OR HANDY TERMINAL OPERATES CORRECTLY.
- CHECK THAT NO FAILURES ARE FOUND IN THE ROBOT.
- CHECK THAT EMERGENCY STOP WORKS CORRECTLY.
- SELECT TEACHING MODE AND DISABLE AUTOMATIC OPERATION.

4.5.2 Automatic operation

Check the following points when operating the robot in AUTO mode. Observe the instructions below in cases where an error occurs during automatic operation. Automatic operation described here includes all operations in AUTO mode.

1. Checkpoints before starting automatic operation

Check the following points before starting automatic operation

DANGER

- CHECK THAT NO ONE IS WITHIN THE SAFETY ENCLOSURE.
- CHECK THE SAFETY ENCLOSURE IS SECURELY INSTALLED WITH INTERLOCKS FUNCTIONAL.

WARNING

- CHECK THAT THE PROGRAMMING BOX / HANDY TERMINAL AND TOOLS ARE IN THEIR SPECIFIED LOCATIONS.
- CHECK THAT THE ALARM OR ERROR LAMPS ON THE ROBOT AND PERIPHERAL EQUIPMENT ARE NOT LIT OR FLASHING.

2. During automatic operation and when errors occur

After automatic operation starts, check the operation status and the signal tower to ensure that the robot is in automatic operation.

DANGER

NEVER ENTER THE SAFETY ENCLOSURE DURING AUTOMATIC OPERATION.

WARNING

IF AN ERROR OCCURS IN THE ROBOT OR PERIPHERAL EQUIPMENT, OBSERVE THE FOLLOWING PROCEDURE BEFORE ENTERING THE SAFETY ENCLOSURE.

1) PRESS THE EMERGENCY STOP BUTTON TO SET THE ROBOT TO EMERGENCY STOP.
2) PLACE A SIGN ON THE START SWITCH, INDICATING THAT THE ROBOT IS BEING INSPECTED IN ORDER TO KEEP OTHER PERSONS FROM RESTARTING THE ROBOT.

4.5.3 Precautions during operation

1. When the robot is damaged or an abnormal condition occurs

WARNING

- IF UNUSUAL ODORS, NOISE OR SMOKE OCCUR DURING OPERATION, IMMEDIATELY TURN OFF POWER TO PREVENT POSSIBLE ELECTRICAL SHOCK, FIRE OR BREAKDOWN. STOP USING THE ROBOT AND CONTACT YOUR DISTRIBUTOR.
- IF ANY OF THE FOLLOWING DAMAGE OR ABNORMAL CONDITIONS OCCURS THE ROBOT, THEN CONTINUING TO OPERATE THE ROBOT IS DANGEROUS. IMMEDIATELY STOP USING THE ROBOT AND CONTACT YOUR DISTRIBUTOR.

Damage or abnormal condition	Type of danger
Damage to machine harness or robot cable	Electrical shock, robot malfunction
Damage to robot exterior	Damaged parts fly off during robot operation
Abnormal robot operation (position deviation, vibration, etc.)	Robot malfunction
Z-axis (vertical axis) or brake malfunction	Loads fall off

2. High temperature hazard

WARNING

- DO NOT TOUCH THE ROBOT CONTROLLER AND ROBOT DURING OPERATION. THE ROBOT CONTROLLER AND ROBOT BODY ARE VERY HOT DURING OPERATION, SO BURNS MAY OCCUR IF THESE SECTIONS ARE TOUCHED.
- THE MOTOR AND SPEED REDUCTION GEAR CASING ARE VERY HOT SHORTLY AFTER OPERATION, SO BURNS MAY OCCUR IF THESE ARE TOUCHED. BEFORE TOUCHING THOSE PARTS FOR INSPECTIONS OR SERVICING, TURN OFF THE CONTROLLER, WAIT FOR A WHILE AND CHECK THAT THEIR TEMPERATURE HAS COOLED.

3. Use caution when releasing the Z-axis (vertical axis) brake

WARNING

THE VERTICAL AXIS WILL SLIDE DOWNWARD WHEN THE BRAKE IS RELEASED, CAUSING A HAZARDOUS SITUATION.

- PRESS THE EMERGENCY STOP BUTTON AND PLACE A SUPPORT UNDER THE VERTICAL AXIS BEFORE RELEASING THE BRAKE.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND THE INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.

4. Be careful of Z-axis movement when the controller is turned off or emergency stop is triggered (air-driven Z-axis)

WARNING

THE Z-AXIS STARTS MOVING UPWARD WHEN POWER TO THE CONTROLLER OR PLC IS TURNED OFF, THE PROGRAM IS RESET, EMERGENCY STOP IS TRIGGERED, OR AIR IS SUPPLIED TO THE SOLENOID VALVE FOR THE Z-AXIS AIR CYLINDER.

- DO NOT LET HANDS OR FINGERS GET CAUGHT AND SQUEEZED BY ROBOT PARTS MOVING ALONG THE Z-AXIS.
- KEEP THE USUAL ROBOT POSITION IN MIND SO AS TO PREVENT THE Z-AXIS FROM HANGING UP OR BINDING ON OBSTACLES DURING RAISING OF THE Z-AXIS EXCEPT IN CASE OF EMERGENCY STOP.

5. Take protective measures when the Z-axis interferes with peripheral equipment (air-driven Z-axis)

WARNING

WHEN THE Z-AXIS COMES TO A STOP DUE TO OBSTRUCTION FROM PERIPHERAL EQUIPMENT, THE Z-AXIS MAY MOVE SUDDENLY AFTER THE OBSTRUCTION IS REMOVED, CAUSING INJURY SUCH AS PINCHED OR CRUSHED HANDS.

- TURN OFF THE CONTROLLER AND REDUCE THE AIR PRESSURE BEFORE ATTEMPTING TO REMOVE THE OBSTRUCTION.
- BEFORE REDUCING THE AIR PRESSURE, PLACE A SUPPORT UNDER THE Z-AXIS BECAUSE THE Z-AXIS WILL DROP UNDER ITS OWN WEIGHT.

6. Be careful of Z-axis movement when air supply is stopped (air-driven Z-axis)

WARNING

THE Z-AXIS WILL SLIDE DOWNWARD WHEN THE AIR PRESSURE TO THE Z-AXIS AIR CYLINDER SOLENOID VALVE IS REDUCED, CREATING A HAZARDOUS SITUATION.
TURN OFF THE CONTROLLER AND PLACE A SUPPORT UNDER THE Z-AXIS BEFORE CUTTING OFF THE AIR SUPPLY.

7. Make correct parameter settings

CAUTION

The robot must be operated with the correct tolerable moment of inertia and acceleration coefficients that match the manipulator tip mass and moment of inertia. Failure to follow this instruction will lead to a premature end to the drive unit service life, damage to robot parts, or cause residual vibration during positioning.

8. If the X-axis, Y-axis or R-axis rotation angle is small

CAUTION

If the X-axis, Y-axis or R-axis rotation angle is set smaller than 5 degrees, then it will always move within the same position. This restricted position makes it difficult for an oil film to form on the joint support bearing, and so may possibly damage the bearing. In this type of operation, add a range of motion so that the joint moves through 90 degrees or more, about 5 times a day.

4.6 Inspection and maintenance

Always perform daily and periodic inspections and make a pre-operation check to ensure there are no problems with the robot and related equipment. If a problem or abnormality is found, then promptly repair it or take other measures as necessary.
Keep a record of periodic inspections or repairs and store this record for at least 3 years.

4.6.1 Before inspection and maintenance work

1. Do not attempt any work or operation unless described in this manual.

Never attempt any work or operation unless described in this manual.
If an abnormal condition occurs, please be sure to contact your distributor. Our service personnel will take appropriate action.

WARNING

- NEVER ATTEMPT INSTALLATION, ADJUSTMENT, INSPECTION AND MAINTENANCE UNLESS DESCRIBED IN THIS MANUAL.
- NEVER ATTEMPT ANY REPAIR AND PARTS REPLACEMENT UNLESS DESCRIBED IN THIS MANUAL. THESE TASKS REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS AND MAY ALSO INVOLVE HAZARDS. PLEASE BE SURE TO CONTACT YOUR DISTRIBUTOR FOR ADVICE.

2. Precautions during repair and parts replacement

WARNING

WHEN IT IS NECESSARY TO REPAIR OR REPLACE PARTS OF THE ROBOT OR CONTROLLER, PLEASE BE SURE TO CONTACT YOUR DISTRIBUTOR AND FOLLOW THE INSTRUCTIONS THEY PROVIDE. INSPECTION AND MAINTENANCE OF THE ROBOT OR CONTROLLER BY AN UNSKILLED, UNTRAINED PERSON IS EXTREMELY HAZARDOUS.

Adjustment, maintenance and parts replacement require specialized technical knowledge and skills, and also may involve hazards. These tasks must be performed only by persons who have enough ability and qualifications required by local laws and regulations.

WARNING

ADJUSTMENT AND MAINTENANCE BY REMOVING A COVER REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS, AND MAY ALSO INVOLVE HAZARDS IF ATTEMPTED BY AN UNSKILLED PERSON. FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.

3. Shut off all phases of power supply

WARNING

ALWAYS SHUT OFF ALL PHASES OF THE POWER SUPPLY EXTERNALLY BEFORE CLEANING THE ROBOT AND CONTROLLER OR SECURELY TIGHTENING THE TERMINAL SCREWS ETC. FAILURE TO DO THIS MAY CAUSE ELECTRICAL SHOCK OR PRODUCT DAMAGE OR MALFUNCTION.

4. Allow a waiting time after power is shut off (Allow time for temperature and voltage to drop)

WARNING

- WHEN PERFORMING MAINTENANCE OR INSPECTION OF THE ROBOT CONTROLLER UNDER YOUR DISTRIBUTOR'S INSTRUCTIONS, WAIT AT LEAST 30 MINUTES FOR THE RCX SERIES OR 5 MINUTES FOR THE SR1 SERIES AFTER TURNING THE POWER OFF. SOME COMPONENTS IN THE ROBOT CONTROLLER ARE VERY HOT OR STILL RETAIN A HIGH VOLTAGE SHORTLY AFTER OPERATION, SO BURNS OR ELECTRICAL SHOCK MAY OCCUR IF THOSE PARTS ARE TOUCHED.
- THE MOTOR AND SPEED REDUCTION GEAR CASING ARE VERY HOT SHORTLY AFTER OPERATION, SO BURNS MAY OCCUR IF THEY ARE TOUCHED. BEFORE TOUCHING THOSE PARTS FOR INSPECTIONS OR SERVICING, TURN OFF THE CONTROLLER, WAIT FOR A WHILE AND CHECK THAT THE TEMPERATURE HAS COOLED.

5. Precautions during inspection of controller

WARNING

- WHEN YOU NEED TO TOUCH THE TERMINALS OR CONNECTORS ON THE OUTSIDE OF THE CONTROLLER DURING INSPECTION, ALWAYS FIRST TURN OFF THE CONTROLLER POWER SWITCH AND ALSO THE POWER SOURCE IN ORDER TO PREVENT POSSIBLE ELECTRICAL SHOCK.
- DO NOT DISASSEMBLE THE CONTROLLER. NEVER TOUCH ANY INTERNAL PARTS OF THE CONTROLLER. DOING SO MAY CAUSE BREAKDOWN, MALFUNCTION, INJURY, OR FIRE.

4.6.2 Precautions during service work

1. Precautions when removing a motor (Cartesian robots and vertical mount single-axis robots)

WARNING

THE VERTICAL AXIS WILL SLIDE DOWN WHEN THE MOTOR IS REMOVED, CAUSING A HAZARDOUS SITUATION.

- TURN OFF THE CONTROLLER AND PLACE A SUPPORT UNDER THE VERTICAL AXIS BEFORE REMOVING THE MOTOR.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BY THE DRIVING UNIT OF THE VERTICAL AXIS OR BETWEEN THE VERTICAL AXIS AND THE INSTALLATION BASE.

2. Be careful when removing the Z-axis motor (SCARA robots)

WARNING

THE Z-AXIS WILL SLIDE DOWNWARD WHEN THE Z-AXIS MOTOR IS REMOVED, CAUSING A HAZARDOUS SITUATION.

- TURN OFF THE CONTROLLER AND PLACE A SUPPORT UNDER THE Z-AXIS BEFORE REMOVING THE Z-AXIS MOTOR.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BY THE DRIVING UNIT OF THE Z-AXIS OR BETWEEN THE Z-AXIS DRIVE UNIT AND THE INSTALLATION BASE.

3. Do not remove the Z-axis upper limit mechanical stopper

CAUTION

Warning label 4 is attached to each SCARA robot. (For details on warning labels, see "3. Warning labels" in "Safety instructions.")

Removing the upper limit mechanical stopper installed to the Z-axis spline or shifting its position will damage the Z-axis ball screw. Never attempt to remove it.

4. Use caution when handling a robot that contains powerful magnets

WARNING

POWERFUL MAGNETS ARE INSTALLED INSIDE THE ROBOT. DO NOT DISASSEMBLE THE ROBOT SINCE THIS MAY CAUSE INJURY. DEVICES THAT MAY MALFUNCTION DUE TO MAGNETIC FIELDS MUST BE KEPT AWAY FROM THIS ROBOT.

5. Use the following caution items when disassembling or replacing the pneumatic equipment.

WARNING

AIR OR PARTS MAY FLY OUTWARD IF PNEUMATIC EQUIPMENT IS DISASSEMBLED OR PARTS REPLACED WHILE AIR IS STILL SUPPLIED.

- DO SERVICE WORK AFTER TURNING OFF THE CONTROLLER, REDUCING THE AIR PRESSURE, AND EXHAUSTING THE RESIDUAL AIR FROM THE PNEUMATIC EQUIPMENT.
- BEFORE REDUCING THE AIR PRESSURE, PLACE A SUPPORT STAND UNDER THE Z-AXIS (2-AXIS ROBOTS WITH AIR DRIVEN Z-AXIS) SINCE IT WILL DROP UNDER ITS OWN WEIGHT.

6. Use caution to avoid contact with the controller cooling fan

WARNING

- TOUCHING THE ROTATING FAN MAY CAUSE INJURY.
- IF REMOVING THE FAN COVER, FIRST TURN OFF THE CONTROLLER AND MAKE SURE THE FAN HAS STOPPED.

7. Precautions for robot controllers

CAUTION

- Back up the robot controller internal data on an external storage device. The robot controller internal data (programs, point data, etc.) may be lost or deleted for unexpected reasons. Always make a backup of this data.
- Do not use thinner, benzene, or alcohol to wipe off the surface of the programming box. The surface sheet may be damaged or printed letters or marks erased. Use a soft, dry cloth and gently wipe the surface.
- Do not use a hard or pointed object to press the keys on the programming box. Malfunction or breakdown may result if the keys are damaged. Use your fingers to operate the keys.
- Do not insert any SD memory card other than specified into the SD memory card slot in the programming box. Malfunction or breakdown may result if the wrong memory card is inserted.

4.7 Disposal

When disposing of robots and related items, handle them carefully as industrial wastes. Use the correct disposal method in compliance with your local regulations, or entrust disposal to a licensed industrial waste disposal company.

1. Disposal of lithium batteries

When disposing of lithium batteries, use the correct disposal method in compliance with your local regulations, or entrust disposal to a licensed industrial waste disposal company. We do not collect and dispose of the used batteries.

2. Disposal of packing boxes and materials

When disposing of packing boxes and materials, use the correct disposal method in compliance with your local regulations. We do not collect and dispose of the used packing boxes and materials.

3. Strong magnet

WARNING

STRONG MAGNETS ARE INSTALLED IN THE ROBOT. BE CAREFUL WHEN DISPOSING OF THE ROBOT.

5. Emergency action when a person is caught by robot

If a person should get caught between the robot and a mechanical part such as the installation base, then release the axis.

Emergency action

Release the axis while referring to the following section in the manual for the robot controller.

Controller	Refer to:
RCX240	Section 8, "Freeing a person caught by the robot" in Chapter 1

NOTE

Make a printout of the relevant page in the manual and post it a conspicuous location near the controller.

6. Using the robot safely

6.1 Robot safety functions

Safety functions for YAMAHA robots are described below.

1. Overload detection

This function detects an overload applied to the motor and shuts off the servo power.

If an overload error occurs, take the following measures to avoid such errors:

1. Insert a timer in the program.
2. Reduce the acceleration coefficient.

2. Overheat detection

This function detects an abnormal temperature rise in the driver inside the controller and shuts off the servo power.

If an overheat error occurs, take the following measures to avoid the error:

1. Insert a timer in the program.
2. Reduce the acceleration coefficient.

3. Soft limits

Soft limits can be set on each axis to limit the working envelope in manual operation after return-to-origin and during automatic operation. The working envelope is the area limited by soft limits.

WARNING

SOFT LIMITS MUST BE SET WITHIN THE MOVEMENT RANGE (MECHANICAL STOPPER). IF THE SOFT LIMIT IS SET OUTSIDE THE MOVEMENT RANGE, THEN THE ROBOT AXIS MAY COLLIDE WITH THE MECHANICAL STOPPER AT HIGH SPEED, CAUSING THE OBJECT GRIPPED BY THE END EFFECTOR TO FLY OUTWARD OR DROP, AND THE ROBOT TO MALFUNCTION.

4. Mechanical stoppers

If the servo power is shut off by emergency stop operation or safety function while the robot is moving, then these mechanical stoppers prevent the axis from exceeding the movement range. No mechanical stopper is provided on the rotational axis. The movement range is the area limited by the mechanical stoppers.

- The X and Y axes have mechanical stoppers that are installed at both ends of the maximum movement range. Some robot models have a standard feature that allows changing the mechanical stopper positions. On some other models, the mechanical stopper positions can also be changed by using option parts.
- The Z-axis has a mechanical stopper at the upper end and lower end. The stopper positions can be changed by using option parts.
- No mechanical stopper is provided on the R-axis.

WARNING

AXIS MOVEMENT DOES NOT STOP IMMEDIATELY AFTER THE SERVO POWER SUPPLY IS SHUT OFF BY EMERGENCY STOP OR OTHER SAFETY FUNCTIONS.

5. Z-axis (vertical axis) brake

An electromagnetic brake is installed on the Z-axis to prevent the Z-axis from sliding downward when servo power is OFF. This brake is working when the controller is OFF or the Z-axis servo power is OFF even when the controller is ON. The Z-axis brake can be released by the programming unit / handy terminal or by a command in the program when the controller is ON.

WARNING

THE VERTICAL AXIS WILL SLIDE DOWNWARD WHEN THE Z-AXIS BRAKE IS RELEASED, CREATING A HAZARDOUS SITUATION.

- **PRESS THE EMERGENCY STOP BUTTON AND PLACE A SUPPORT UNDER THE VERTICAL AXIS BEFORE RELEASING THE BRAKE.**
- **BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.**

6.2 Special training for industrial robot operation

Operators or persons who handle the robot for tasks such as for teaching, programming, movement checks, inspections, adjustments, and repairs must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must also read the manual carefully to understand its contents before attempting the robot operation or maintenance.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and safety standards for industrial robots.

This manual does not serve as a guarantee of any industrial property rights or any other rights and does not grant a license in any form. Please acknowledge that we bear no liability whatsoever for any problems involving industrial property rights which may arise from the contents of this manual.

2012 YAMAHA MOTOR CO., LTD.

Revision record

Manual version	Issue date	Description
Ver. 1.00	May 2012	First edition
Ver. 1.01	Jun. 2012	Description of "Emergency action when a person is caught by robot" was added, the work sequence for working within the safety enclosure changed, typing errors corrected, etc.

YAMAHA Safety Instructions

Jun. 2012
Ver. 1.01
This manual is based on Ver. 1.01 of Japanese manual.

YAMAHA MOTOR CO., LTD. IM Operations

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Information furnished by YAMAHA in this manual is believed to be reliable. However, no responsibility is assumed for possible inaccuracies or omissions. If you find any part unclear in this manual, please contact your distributor.

Warranty

For information on the warranty period and terms, please contact our distributor where you purchased the product.

This warranty does not cover any failure caused by:

1. Installation, wiring, connection to other control devices, operating methods, inspection or maintenance that does not comply with industry standards or instructions specified in the YAMAHA manual;
2. Usage that exceeded the specifications or standard performance shown in the YAMAHA manual;
3. Product usage other than intended by YAMAHA;
4. Storage, operating conditions and utilities that are outside the range specified in the manual;
5. Damage due to improper shipping or shipping methods;
6. Accident or collision damage;
7. Installation of other than genuine YAMAHA parts and/or accessories;
8. Modification to original parts or modifications not conforming to standard specifications designated by YAMAHA, including customizing performed by YAMAHA in compliance with distributor or customer requests;
9. Pollution, salt damage, condensation;
10. Fires or natural disasters such as earthquakes, tsunamis, lightning strikes, wind and flood damage, etc;
11. Breakdown due to causes other than the above that are not the fault or responsibility of YAMAHA;

The following cases are not covered under the warranty:

1. Products whose serial number or production date (month & year) cannot be verified.
2. Changes in software or internal data such as programs or points that were created or changed by the customer.
3. Products whose trouble cannot be reproduced or identified by YAMAHA.
4. Products utilized, for example, in radiological equipment, biological test equipment applications or for other purposes whose warranty repairs are judged as hazardous by YAMAHA.

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Introduction

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Before using the single-axis robot FLIP-XC series (Be sure to read the following notes.) i
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Before using the single-axis robot FLIP-XC series (Be sure to read the following notes.)

Thanks for your purchasing YAMAHA single-axis robot FLIP-XC series.
Before using this robot, read the following notes and set the origin position.

The single-axis robot FLIP-XC series uses absolute position detectors that do not require return-to-origin after turning on the controller power again. However, when the controller power is turned on in the following cases, return-to-origin must be performed just the very first time.

1. When robot cable was first connected after delivery from YAMAHA.
2. When robot cable was disconnected from the controller and then reconnected.
3. When no absolute battery is connected.
4. When a motor or cable was replaced.

In such cases described above, any of the following errors occurs immediately after the controller power has been turned on, but this is not a malfunction. The controller will operate normally by restarting.

- **When using an SR1 controller:**

  15 : FEEDBACK ERROR 2
  23 : ABS BAT. LOW VOLTAGE
  24 : ABS DATA ERROR
  ...etc.

- **When using an RCX240, RCX222 controller:**

  17.81 : D?.ABS.battery wire breakage
  17.92 : D?.Resolver disconnected during power off
  17.93 : D?.Position backup counter overflow
  ....etc.

- **When using a TS-X controller:**

  82 ENCODER ERROR
  83 ABS. ENCODER ERR.
  8A ABS. BATTERY ERR.
  8B ABS. COUNT ERROR
  8D ABS. OVERFLOW ERR.
  ....etc.

Setting the origin position

Set the origin position while referring to the following section in the robot controller user's manual.

When using an SR1 controller:

See "9.1.1 Return-to-origin by the search method" in Chapter 9 of the "HPB Operation Guide" section.

When using an RCX240 controller:

See "11.9 Absolute reset" in Chapter 4.

When using an RCX222 controller:

See "11.8 Absolute reset" in Chapter 4.

When using a TS-X controller:

See "6.2 Origin search (return-to-origin)" in "6. Operating the robot" of the "HT1 Operation Guide" section.

CAUTION

Changing the origin position to the opposite side of the initial position may cause a position shift or robot breakdowns, so use caution.
Avoid changing the origin detection method since it is dangerous in some cases. If the origin position must be changed, please consult your distributor.

Introduction

The YAMAHA SINGLE AXIS ROBOT FLIP-XC series a family of single-axis industrial robots that use the absolute positioning method as a standard feature to improve ease of use, resistance to environmental conditions, and maintenance workability. A wide variety of product lineup allows you to select the desired robot model that best matches your application.

This manual describes the safety measures, handling, adjustment and maintenance of FLIP-XC series robots for correct, safe and effective use. Be sure to read this manual carefully before installing the robot. Even after you have read this manual, keep it in a safe and convenient place for future reference.

- This manual should be used with the robot and considered an integral part of it.
  When the robot is moved, transferred or sold, send this manual to the new user along with the robot. Be sure to explain to the new user the need to read through this manual.
- Specifications of robot models other than standard models may be omitted in this manual if they are common to those of standard models. In this case, refer to the specifications of standard models.
- For details on specific operation of the robot, refer to the separate user's manual for the robot controller being used.

WARNING

THE ADJUSTMENT AND MAINTENANCE WORK WITH THE COVER REMOVED NEEDS THE SPECIAL KNOWLEDGE AND SKILL. IF UNSKILLED WORK PERSON PERFORMS SUCH WORK, THIS MAY INVOLVE RISK.
THESE TASKS MUST BE PERFORMED ONLY BY PERSONS WHO HAVE ENOUGH ABILITY AND QUALIFICATIONS IN ACCORDANCE WITH LOCAL LAWS AND REGULATIONS, BY REFERRING TO THE SEPARATE MAINTENANCE MANUAL.
FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.

NOTES

- The contents of this manual are subject to change without prior notice.
- Information furnished by YAMAHA in this manual is believed to be reliable. However, if you find any part unclear or inaccurate in this manual, please contact your distributor.

YAMAHA MOTOR CO., LTD.
IM Operations

Chapter 1 Overview of product

Contents

1. Components making up the product 1-1
2. Part names 1-2

1. Components making up the product

After unpacking, make sure that all components and accessories are included (as specified in your order). Also check the product for any damage on the exterior which might have occurred during transportation. If there are any missing parts or damage due to transportation, please notify your distributor immediately.

Example
Controller : SR1
Robot : C14

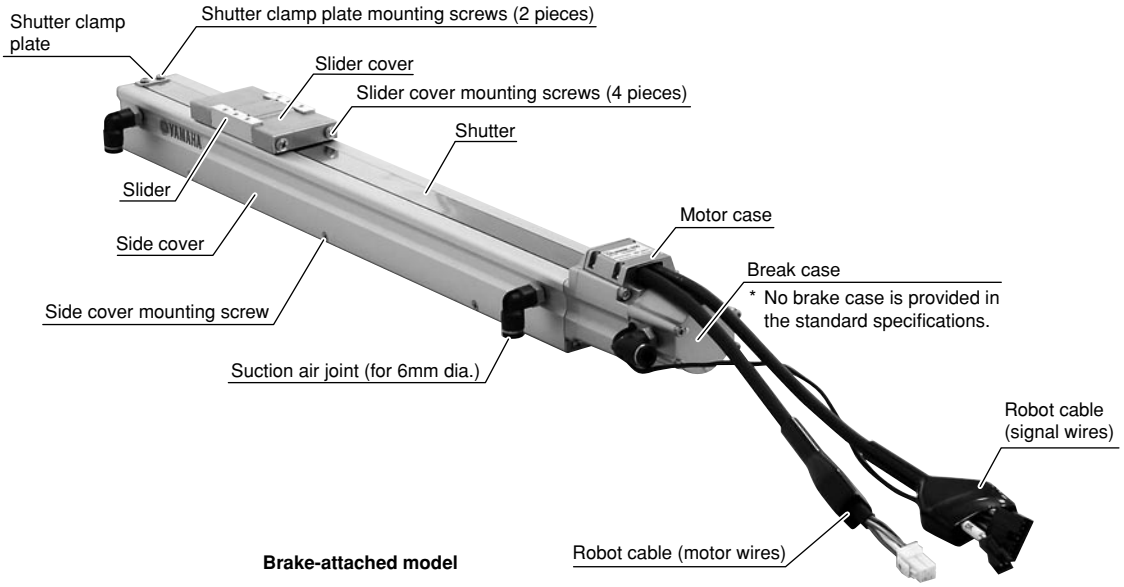
Product name	Qty	
Single-axis robot	1	
SR1	1	
Robot cable	1	
I/O connector	1	
Battery	1	
Battery attachment	1set	
Warning label 1 (Danger label)	1	Affix to a conspicuous spot in the system.
Warning label 3 (Warning label)	1	Affix to a conspicuous spot in the system.
HPB	1	Option
POPCOM	1	Option
SD memory card	1	Option

WARNING

- **TAKE OUT THE ROBOT FROM THE PACKING BOX BY APPROPRIATE WORK PERSONNEL*1. WHEN TWO OR MORE WORK PERSONNEL TAKE OUT THE ROBOT FROM THE PACKING BOX, HOLD THE BOTTOMS CLOSE TO THE BOTH ENDS OF THE ROBOT SECURELY AND TAKE OUT THE ROBOT SAFELY. AT THIS TIME, MOVE THE ROBOT SO THAT IT FACES UPWARD (SLIDER IS LOCATED AT THE TOP).**
  ***1: FOR ROBOTS WITH A WEIGHT OF 30KG OR MORE, TWO OR MORE WORK PERSONNEL MUST WORK TOGETHER. FOR DETAILS ABOUT ROBOT WEIGHT, SEE "1. ROBOT SPECIFICATIONS" IN CHAPTER 5.**
- **WHEN UNPACKING, BE CAREFUL NOT TO DROP THE ROBOT BODY. IF THE ROBOT BODY DROPS, THIS MAY CAUSE SERIOUS PERSONAL INJURY OR DAMAGE TO OTHER UNITS.**

2. Part names

C4L/C4LH/C5L/C5LH/C6L



Brake-attached model

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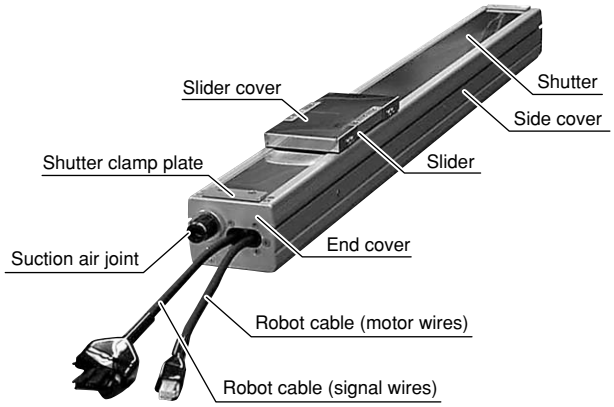
C8/C8L/C8LH



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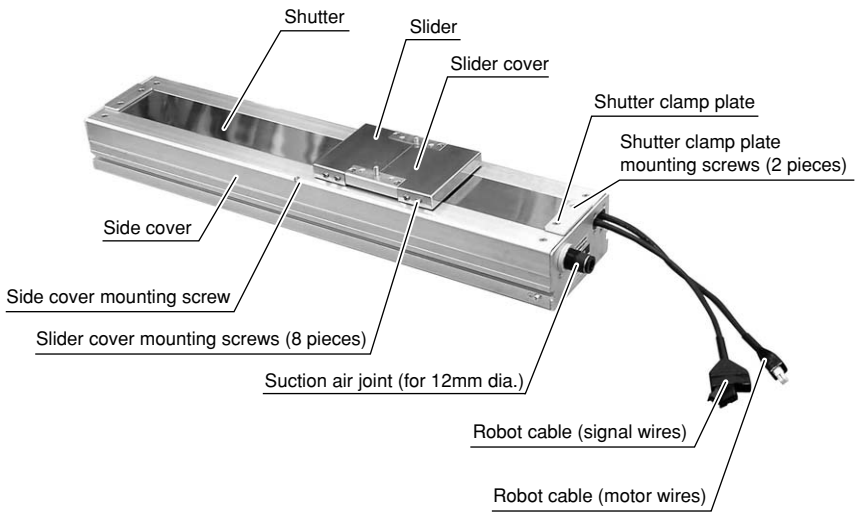
C10/C14/C14H/C17/C17L/C20



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Chapter 2 Installation and connections

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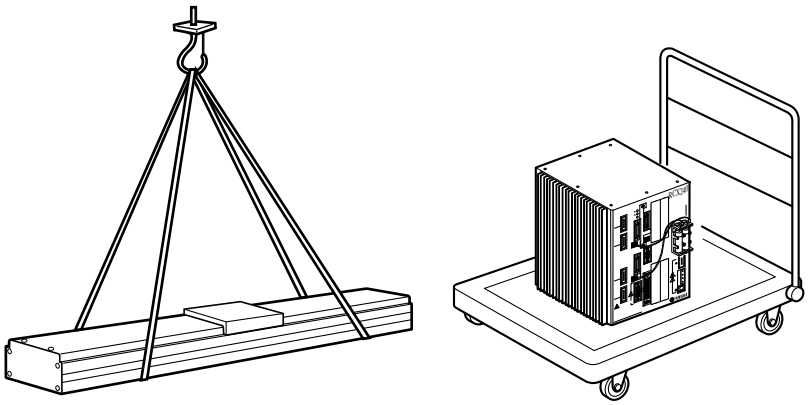
1. Moving the robot

1.1 Moving the robot with hoist or cart

Using a hoist, carrying cart (dolly) or forklift is recommended for moving a single-axis robot or controller. Use sufficient caution when moving robot models with a long stroke or designed for large payload, since they are heavy.

Moving the robot



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WARNING

SERIOUS INJURY MAY OCCUR IF THE ROBOT FALLS AND PINS SOMEONE UNDER IT.

- USE A HOIST AND ROPE WITH CARRYING CAPACITY STRONG ENOUGH TO SUPPORT THE ROBOT WEIGHT.
- MAKE SURE THE ROPE STAYS SECURELY ON THE HOIST HOOK.
- REMOVE ALL LOADS ATTACHED TO THE ROBOT MANIPULATOR END. IF ANY LOAD IS STILL ATTACHED, THE ROBOT BALANCE MIGHT SHIFT WHILE BEING CARRIED, AND THE ROBOT TOPPLE OVER CAUSING ACCIDENTS.
- ALWAYS WEAR A SAFETY HELMET, SHOES AND GLOVES DURING WORK.
- WHEN MOVING THE ROBOT BY EQUIPMENT SUCH AS A FORKLIFT THAT REQUIRES A LICENSE, ONLY PROPERLY QUALIFIED PERSONNEL MAY OPERATE SUCH EQUIPMENT. THE EQUIPMENT AND TOOLS USED FOR MOVING THE ROBOT SHOULD BE SERVICED DAILY.

1.2 Moving the robot by work personnel

Be sure to move the robot by a reasonable number of work personnel. (*1) Each work person holds the bottom close to the both ends of the robot and moves the robot while keeping its balance. At this time, move the robot so that it faces upward (slider is located at the top).

*1 : For robots with a weight of 30kg or more, two or more work personnel must work together. For details about robot weight, see "1. Robot specifications" in Chapter 5.

WARNING

ALWAYS OBSERVE THE FOLLOWING PRECAUTIONS WHEN CARRYING THE ROBOT.

- **REMOVE ANY AND ALL OBJECTS SUCH AS HANDS AND GRIPPERS ATTACHED TO THE ROBOT SLIDER BEFORE MOVING THE ROBOT. THE SLIDER WILL LOSE BALANCE IF MOVED WITH OBJECTS STILL ATTACHED AND CAUSE INJURIES.**
- **KEEP THE ROBOT BALANCED AND DON'T LET IT TILT WHILE MOVING IT. IF THE ROBOT TILTS, THE SLIDER MAY MOVE UNDER ITS OWN WEIGHT CAUSING SERIOUS INJURIES SUCH AS CRUSHED FINGERS.**
- **MOVE THE SLIDER SO THAT BALL NUT SECTION IS POSITIONED IN THE NEAR CENTER OF THE ROBOT BEFORE CARRYING THE ROBOT. FAILURE TO DO SO MAY CAUSE THE BALL SCREW TO SWING OR VIBRATE LARGELY WHILE CARRYING THE ROBOT.**
- **NEVER ATTEMPT TO HOLD THE ROBOT IN ANY OF THE FOLLOWING MANNERS. (NEVER TRY THIS WHEN MOVING!)**
  - **DO NOT CARRY BY HOLDING THE SLIDER.**
  - **DO NOT CARRY BY HOLDING THE CABLE.**
  - **DO NOT CARRY BY GRIPPING THE END COVER.**
  - **DO NOT CARRY BY HOLDING THE UPPER COVER.**

CAUTION

- **When moving or carrying the robot by hand, avoid placing your hand or fingers on the shutter at the top of the robot. Pressing down on the shutter, even by a little force, may cause the shutter to warp or deform, resulting in a premature life end of the related parts.**
- **Wear safety shoes and gloves before starting the work.**

2. Robot installation conditions

2.1 Installation environments

Be sure to install the robot in the following environments.

Items	Specifications
Allowable ambient temperature	0 to 45°C
Allowable ambient humidity	35 to 85% RH (non condensation)
Altitude	0 to 1000 meters above sea level
Ambient environments	Avoid installing near water, cutting water, oil, dust, metallic chips and organic solvent. Avoid installation near corrosive gas and corrosive materials. Avoid installation in atmosphere containing inflammable gas, dust and liquid. Avoid installation near objects causing electromagnetic interference, electrostatic discharge and radio frequency interference.
Vibration	Do not subject to impacts or vibrations.
Working space	Allow sufficient space margin to perform jobs (teaching, inspection, repair, etc.)

For detailed information on how to install the robot controller, refer to the separate "YAMAHA Robot Controller User's Manual".

WARNING

- AVOID INSTALLING THE ROBOT IN LOCATIONS WHERE THE AMBIENT CONDITIONS MAY EXCEED THE ALLOWABLE TEMPERATURE OR HUMIDITY, OR IN ENVIRONMENTS WHERE EXCESSIVE MOISTURE, CORROSIVE GASES, METALLIC POWDER OR DUST ARE GENERATED.
  MALFUNCTIONS, FAILURES OR SHORT CIRCUITS MAY OTHERWISE RESULT.
- THIS ROBOT WAS NOT DESIGNED FOR OPERATION IN ENVIRONMENTS WHERE INFLAMMABLE OR EXPLOSIVE SUBSTANCES ARE PRESENT.
- DO NOT USE THE ROBOT IN ENVIRONMENTS CONTAINING INFLAMMABLE GAS, DUST OR LIQUIDS. EXPLOSIONS OR FIRE COULD OTHERWISE RESULT.
- AVOID USING THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. MALFUNCTIONS MAY OTHERWISE OCCUR.
- DO NOT USE THE ROBOT IN LOCATIONS SUBJECT TO EXCESSIVE VIBRATION. ROBOT INSTALLATION BOLTS MAY OTHERWISE BECOME LOOSE CAUSING THE MANIPULATOR TO FALL OVER.

2.2 Installation base

To mount the robot, use an installation base that satisfies the following conditions.

1. The installation base is subjected to a great deal of stress while the robot is in operation. Prepare a sufficiently rigid and stable installation base, taking into account the robot weight including the end effector (gripper) and workpiece.

WARNING

IF THE INSTALLATION BASE IS NOT SUFFICIENTLY RIGID AND STABLE, VIBRATION (RESONANCE) MAY OCCUR DURING OPERATION, CAUSING ADVERSE EFFECTS ON THE ROBOT WORK.

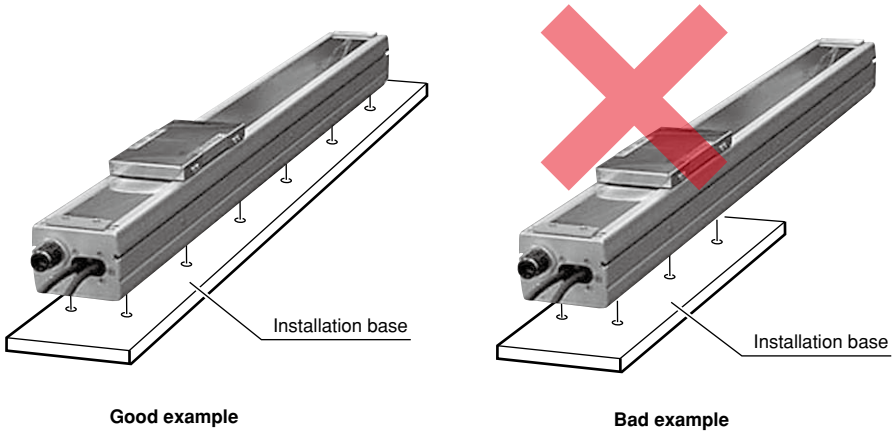
2. The installation base surface must be machined within a flatness of ±0.05mm/500mm.

CAUTION

The robot positioning accuracy might decrease if the installation surface precision is insufficient.

3. Use an installation base of sufficient size to match the robot body so that the robot can be installed with the specified number of bolts. Avoid installing the robot with less than the specified number of bolts or installing the robot closer to one end as shown at the lower right.

Robot installation example



Good example **Bad example**

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WARNING

WHEN INSTALLING THE ROBOT, ALWAYS USE ALL THE MOUNTING HOLES DRILLED IN THE BOTTOM OF THE ROBOT. USING LESS THAN THE SPECIFIED NUMBER OF BOLTS TO INSTALL THE ROBOT MAY CAUSE VIBRATION AND POOR POSITIONING ACCURACY. THIS MAY ALSO RESULT IN POSITIONING ERRORS AND REDUCED SERVICE LIFE IN THE WORST CASES.

NOTE

Positions of robot mounting holes differ according to the stroke length of each robot. For details, see the external view and dimensions stated in "1. Robot specifications" of Chapter 5.

3. Installing the robot

3.1 C4L/C4LH/C5L/C5LH/C6L

C4L/C4LH : Drill holes through the installation base, and secure the robot to the base with M4 bolts from the bottom.

C5L/C5LH/C6L : Drill holes through the installation base, and secure the robot to he base with M5 bolts from the bottom.

WARNING

BEFORE INSTALLING THE ROBOT, ALWAYS MAKE SURE THAT THE ROBOT CONTROLLER IS NOT CONNECTED TO THE ROBOT OR THE POWER TO THE CONTROLLER IS OFF. SERIOUS ACCIDENTS MAY OCCUR IF THE ROBOT STARTS TO OPERATE DURING INSTALLATION.

CAUTION

Be sure to wear safety gloves before starting the installation work. If you touch any steel material part by bare hand, this may cause rust.

Installation method

Drill holes through the installation base where the robot is to be secured. Then secure the robot with the specified bolts from the underside of the installation base.
The bolt and tightening torque are shown below.

WARNING

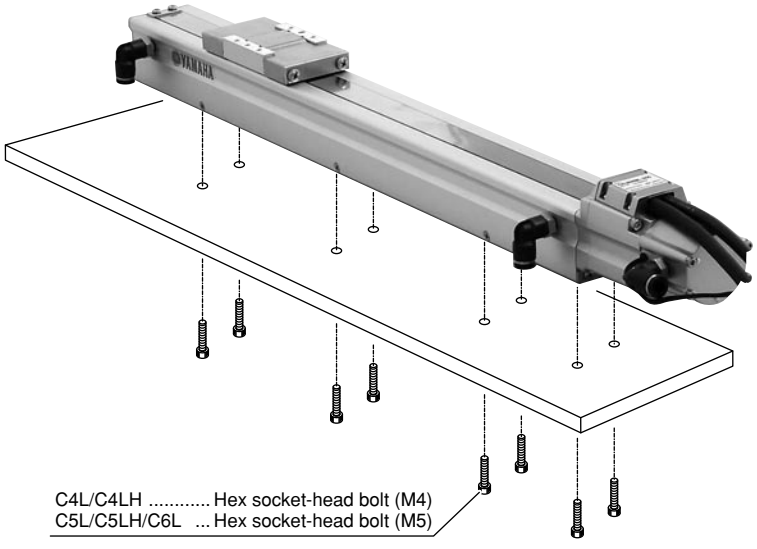
- **BE SURE TO TIGHTEN THE BOLT TO THE CORRECT TORQUE. THE WRONG TORQUE MAY NOT ONLY CAUSE ROBOT POSITION ERRORS BUT ALSO LEAD TO SERIOUS ACCIDENTS.**
- **DO NOT USE A BOLT LONGER THAN THE SPECIFIED LENGTH. A BOLT THAT IS TOO LONG WILL PENETRATE INSIDE THE ROBOT FRAME AND CAUSE OPERATING DEFECTS OR MALFUNCTION.**

Robot	Bolt	Tightening torque
C4L/C4LH	Hex socket-head bolt (M4), Strength: 8.8T base thickness + 5mm (maximum) is recommended	30kgf•cm to 45kgf•cm
C5L/C5LH/C6L	Hex socket-head bolt (M5), Strength: 8.8T base thickness + 5mm (maximum) is recommended	60kgf•cm to 90kgf•cm

CAUTION

- **The robot frame is made of aluminum so be careful not to damage the screw threads when tightening the bolt.**
- **To keep the cleanliness, clean the robot surface with alcohol to remove the dust or dirt sticking to the surface. Additionally, use the suction hoses to suck the air from the inside of the robot.**

C4L/C4LH/C5L/C5LH/C6L



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NOTE

For details about hole and bolt machining dimensions and positions of the robot installation base surface, see the external view and dimensions stated in "1. Robot specifications" of Chapter 5.

3.2 C8/C8L/C8LH

To install the C8/C8L/C8LH, drill holes through the installation base, and secure the robot to the base with M5 bolts from the bottom.

WARNING

BEFORE INSTALLING THE ROBOT, ALWAYS MAKE SURE THAT THE ROBOT CONTROLLER IS NOT CONNECTED TO THE ROBOT OR THE POWER TO THE CONTROLLER IS OFF. SERIOUS ACCIDENTS MAY OCCUR IF THE ROBOT STARTS TO OPERATE DURING INSTALLATION.

CAUTION

Be sure to wear safety gloves before starting the installation work. If you touch any steel material part by bare hand, this may cause rust.

Installation method

Drill holes through the installation base where the robot is to be secured. Then secure the robot with the specified bolts from the underside of the installation base.
The bolt and tightening torque are shown below.

WARNING

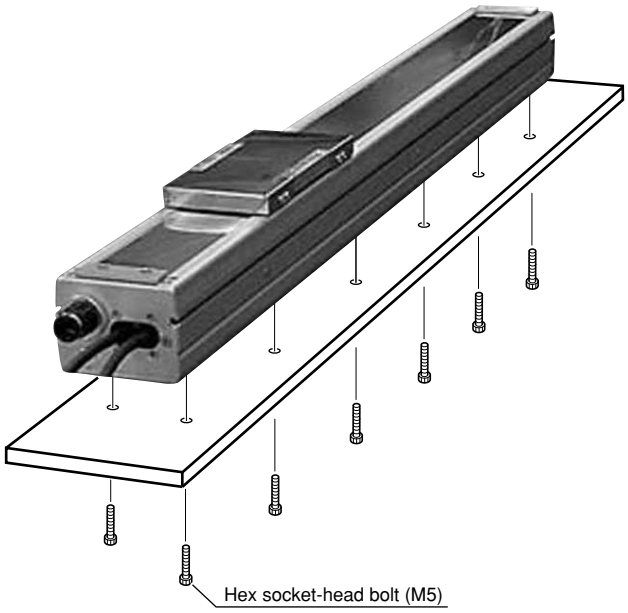
- **BE SURE TO TIGHTEN THE BOLT TO THE CORRECT TORQUE. THE WRONG TORQUE MAY NOT ONLY CAUSE ROBOT POSITION ERRORS BUT ALSO LEAD TO SERIOUS ACCIDENTS.**
- **DO NOT USE A BOLT LONGER THAN THE SPECIFIED LENGTH. A BOLT THAT IS TOO LONG WILL PENETRATE INSIDE THE ROBOT FRAME AND CAUSE OPERATING DEFECTS OR MALFUNCTION.**

Robot	Bolt	Tightening torque
C8/C8L/C8LH	Hex socket-head bolt (M5), Strength: 8.8T base thickness + 9mm (maximum) is recommended	60kgf•cm to 90kgf•cm

CAUTION

- **The robot frame is made of aluminum so be careful not to damage the screw threads when tightening the bolt.**
- **To keep the cleanliness, clean the robot surface with alcohol to remove the dust or dirt sticking to the surface. Additionally, use the suction hoses to suck the air from the inside of the robot.**

Installing the C8/C8L/C8LH



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NOTE

For details about hole and bolt machining dimensions and positions of the robot installation base surface, see the external view and dimensions stated in "1. Robot specifications" of Chapter 5.

3.3 C10/C14/C14H/C17/C17L/C20

C10 : Drill holes through the installation base, and secure the robot to the base with M5 bolts from the bottom.
C14/C14H : Drill holes through the installation base, and secure the robot to the base with M6 bolts from the bottom.
C17/C17L/C20 : Drill holes through the installation base, and secure the robot to he base with M8 bolts from the bottom.

WARNING

BEFORE INSTALLING THE ROBOT, ALWAYS MAKE SURE THAT THE ROBOT CONTROLLER IS NOT CONNECTED TO THE ROBOT OR THE POWER TO THE CONTROLLER IS OFF. SERIOUS ACCIDENTS MAY OCCUR IF THE ROBOT STARTS TO OPERATE DURING INSTALLATION.

CAUTION

Be sure to wear safety gloves before starting the installation work. If you touch any steel material part by bare hand, this may cause rust.

Installation method

Drill holes through the installation base where the robot is to be secured. Then secure the robot with the specified bolts from the underside of the installation base. The bolt and tightening torque are shown below.

WARNING

- **BE SURE TO TIGHTEN THE BOLT TO THE CORRECT TORQUE. THE WRONG TORQUE MAY NOT ONLY CAUSE ROBOT POSITION ERRORS BUT ALSO LEAD TO SERIOUS ACCIDENTS.**
- **DO NOT USE A BOLT LONGER THAN THE SPECIFIED LENGTH. A BOLT THAT IS TOO LONG WILL PENETRATE INSIDE THE ROBOT FRAME AND CAUSE OPERATING DEFECTS OR MALFUNCTION.**

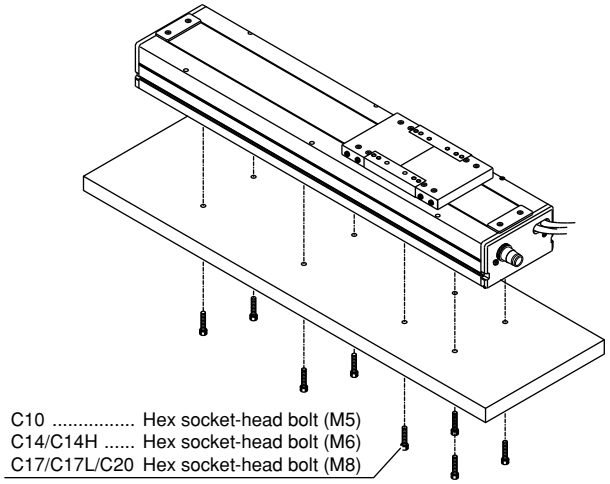
Robot	Bolt	Tightening torque
C10	Hex socket-head bolt (M5), Strength: 8.8T base thickness + 10mm (maximum) is recommended	60kgf•cm to 90kgf•cm
C14/C14H	Hex socket-head bolt (M6), Strength: 8.8T base thickness + 10mm (maximum) is recommended	100kgf•cm to 130kgf•cm
C17/C17L/C20	Hex socket-head bolt (M8), Strength: 8.8T base thickness + 15mm (maximum) is recommended	230kgf•cm to 370kgf•cm

* Because the robot frame has a cavity inside the tapped holes, it is possible to use bolts whose length is up to the installation base thickness + 20mm. Even in this case, the length of the bolt thread engagement is 10mm.

CAUTION

- **The robot frame is made of aluminum so be careful not to damage the screw threads when tightening the bolt.**
- **To keep the cleanliness, clean the robot surface with alcohol to remove the dust or dirt sticking to the surface. Additionally, use the suction hoses to suck the air from the inside of the robot.**

Installing the C10/C14/C14H/C17/C17L/C20



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NOTE

For details about hole and bolt machining dimensions and positions of the robot installation base surface, see the external view and dimensions stated in "1. Robot specifications" of Chapter 5.

4. Protective bonding

WARNING

ALWAYS GROUND THE ROBOT AND CONTROLLER UNIT TO PREVENT ELECTRICAL SHOCK.

Always use the ground terminal (M4 screw) on the robot unit to make ground connection. The ground terminal location is shown below.

CAUTION

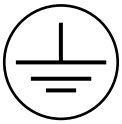
- **A secure ground connection (less than 100-ohm resistance to ground) is recommended.**
- **Use electrical wire thicker than AWG14 (2mm^2) as the ground wire.**

WARNING

ALWAYS TURN OFF THE POWER TO THE CONTROLLER BEFORE MAKING THE GROUND CONNECTION.

Provide a terminal marked "PE" as the protective conductor for the entire system, and connect it to an external protective conductor. Also securely connect the ground terminal on the robot frame to the protective conductor.

Grounding



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5. Connections

5.1 Connecting the robot to the controller

Follow the steps below to connect the robot cables of the robot main body to the mating connectors on the controller. For details about connection connectors on the controller side, see the User's Manual for controller to be used.

WARNING

- BEFORE CONNECTING THE CABLES, CHECK THAT THERE ARE NO BENDS OR BREAKS IN THE ROBOT CABLE CONNECTOR PINS AND THAT THE CABLES ARE NOT DAMAGED. CONTACT FAILURE MAY CAUSE ROBOT MALFUNCTIONS.
- ALWAYS MAKE SURE THAT THE POWER TO THE ROBOT CONTROLLER IS OFF BEFORE CONNECTING THE ROBOT CABLES TO THE CONTROLLER.

WARNING

- IF ANY CONNECTOR IS CONNECTED INCOMPLETELY AND ANY PIN HAS FAULTY CONTACT, THE ROBOT MAY MALFUNCTION, LEADING TO HAZARDOUS SITUATION. BEFORE TURNING ON THE CONTROLLER POWER, MAKE SURE THAT EACH CONNECTOR IS CONNECTED SECURELY.
- TAKE APPROPRIATE MEASURES SO THAT NO LOAD IS APPLIED TO THE CONNECTOR EVEN WHEN THE ROBOT CABLE IS STRETCHED.

WARNING

- ARRANGE THE ROBOT CABLES SO THAT THEY DO NOT HINDER THE ROBOT OPERATION. ADDITIONALLY, DO NOT USE AN AREA WHERE ANY ROBOT CABLE INTERFERES WITH THE LOAD ATTACHED TO THE ROBOT TIP AS WORK AREA. IF ANY CABLE INTERFERES WITH THE ROBOT MOVABLE PART, THIS MAY CAUSE THE ROBOT TO MALFUNCTION, LEADING TO HAZARDOUS SITUATION.
- ARRANGE THE ROBOT CABLES SO THAT THE CONNECTED CABLES DO NOT HINDER A WORK PERSON. IF A WORK PERSON STUMBLES OVER ANY ROBOT CABLE AND FALLS DOWN, THIS MAY CAUSE PERSONAL INJURY.

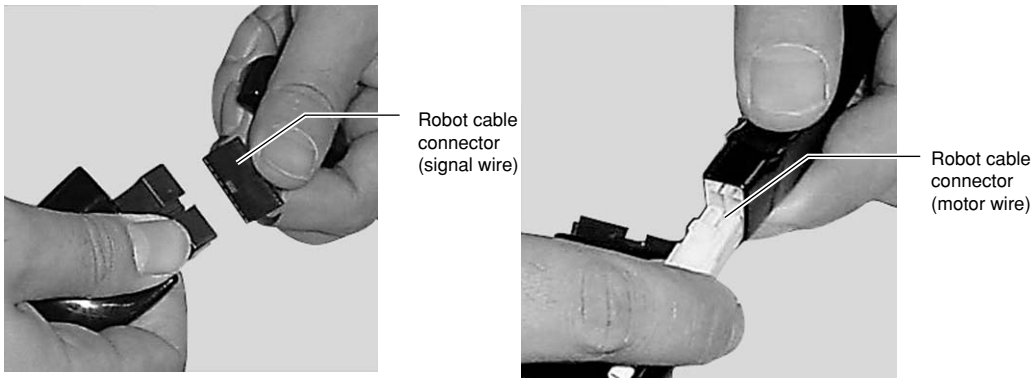
CAUTION

- After connecting the relay connectors on the robot cables, fit the connector hoods together securely.
- The standard robot cables are not movable cables. So, connect the cables so that the motor power cable and signal cable connectors of the robot cables do not move.

■ Connections

Step 1 Connect the robot cables (motor and signal wires) to the mating connectors coming out from the robot.

Connecting the power cable and signal cable



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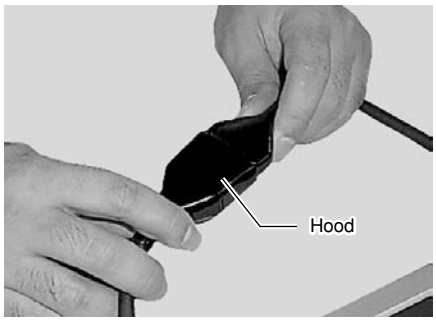
Step2 After making the connections, fit the connector hoods together securely.

Connecting the hoods



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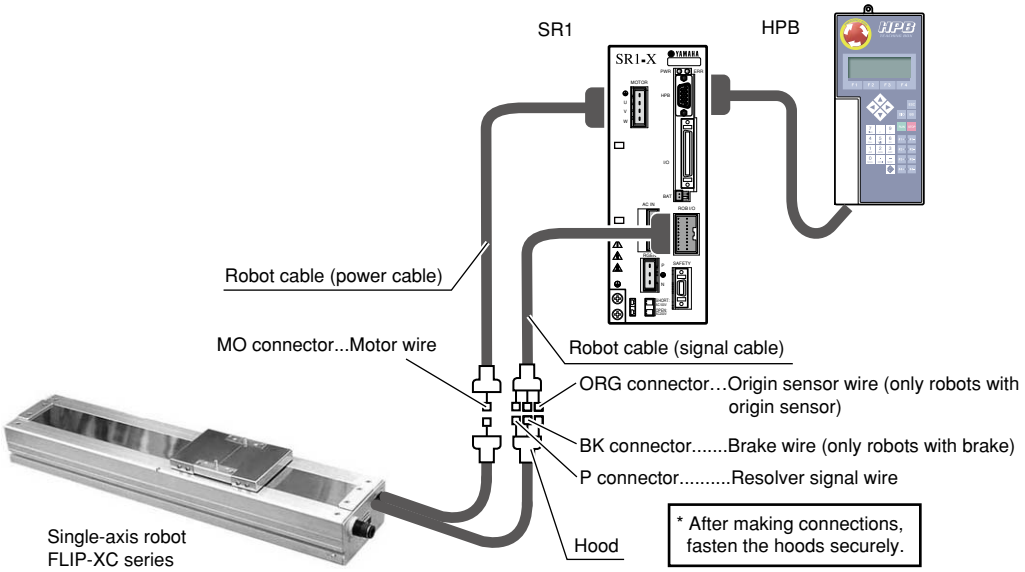
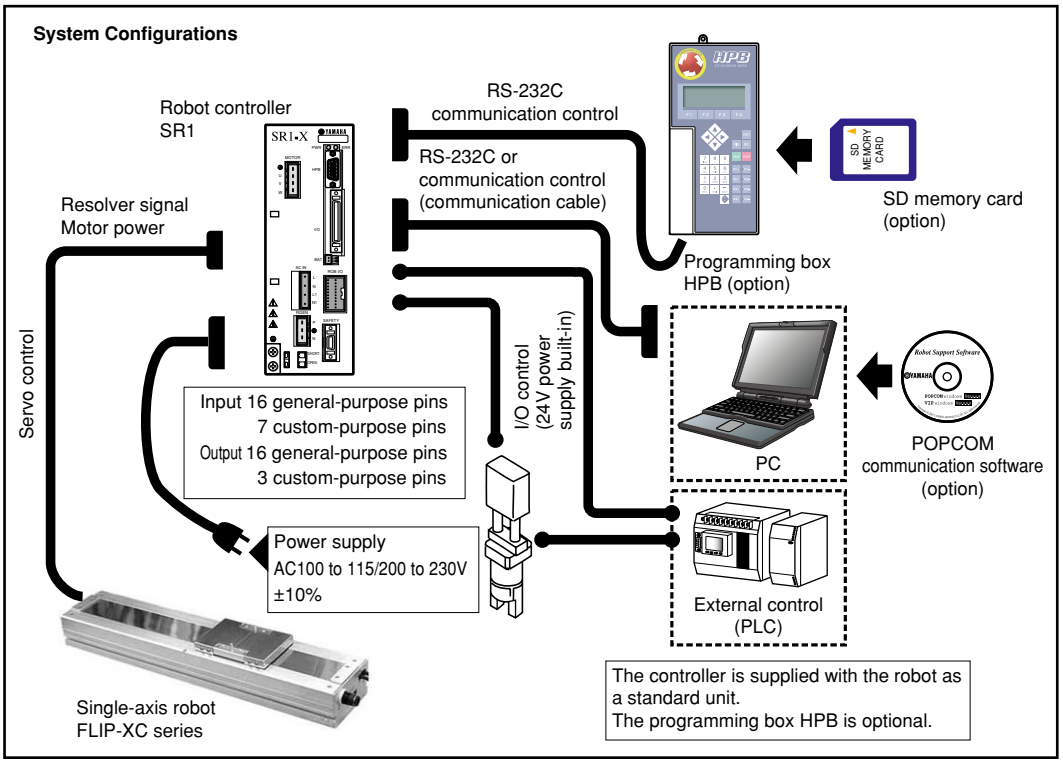
Robot cable connections (when connected to SR1)





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6. Suction hoses connection

The FLIP-X Type C series robots are designed to connect to an air unit that suctions air inside the robot to maintain cleanliness. When using the robot in a clean room, adjust the suction air to the specified flow rate. (For the suction hose attachment position on each robot, refer to "2. Part names" in Chapter 1.)

■ Suction hose

Model No.	Hose diameter	Number of hoses	Suction rate (Nℓ /min.)
C4L	ϕ6	2	15 to 50
C4LH (with brake)	ϕ6	3	15 to 50
C4LH	ϕ6	2	15 to 50
C4LH (with brake)	ϕ6	3	15 to 50
C5L	ϕ6	2	30 to 80
C5L (with brake)	ϕ6	3	30 to 80
C5LH	ϕ6	2	30 to 80
C5LH (with brake)	ϕ6	3	30 to 80
C6L	ϕ6	2	30 to 80
C6L (with brake)	ϕ6	3	30 to 80
C8	ϕ10	1	30 to 90
C8 (with brake)	ϕ10	1	30 to 90
C8L	ϕ10	1	30 to 90
C8L (with brake)	ϕ10	1	30 to 90
C8LH	ϕ10	1	30 to 90
C8LH (with brake)	ϕ10	1	30 to 90
C10	ϕ12	1	30 to 90
C10 (with brake)	ϕ12	1	30 to 90
C14	ϕ12	1	30 to 90
C14 (with brake)	ϕ12	1	30 to 90
C14H	ϕ12	1	30 to 90
C14H (with brake)	ϕ12	1	30 to 90
C17	ϕ12	1	30 to 90
C17 (with brake)	ϕ12	1	30 to 90
C17L	ϕ12	1	30 to 90
C17L (with brake)	ϕ12	1	30 to 90
C20	ϕ12	1	30 to 90
C20 (with brake)	ϕ12	1	30 to 90

Note) Arrange the suction hoses so that the total suction rate will be 15 to 50 [Nℓ/min.] or more for the C4L/C4LH and 30 to 80 [Nℓ/min.] or more for the C5L/C5LH and C6L.

CAUTON

Avoid excessive bends in the air hoses. Lay out the air hoses to keep the hose length to the air unit as short as possible. Too long of a hose may prevent obtaining the specifi ed suction fl ow rate.

NOTE

It is recommended that a hose with as large outside diameter as possible is connected to the suction source and the outside diameter of the hose is converted to the specified outside diameter at a position of 100mm away from the robot.

7. Setting the operating conditions

7.1 Payload

As the payload parameter is set for the controller, optimal acceleration setting is performed automatically. Set the total weight of the workpiece and the end effectors such as grippers attached to the robot slider in the payload parameter as shown below.

CAUTION

Be sure to enter an accurate value when making this setting, since a mistake will cause troubles such as vibration or a shorter machine service life span.

■ To set the payload parameter

The following describes how to set the payload parameter for the SR1. For other controllers, see the User's Manual for relevant controller.

Step 1 ***Press*** F3 ***(SYS) on the initial menu screen.***

The SYS (system) mode screen appears.

24201-A0-00

Step 2 ***Press*** F1 ***(PRM) to enter the parameter setting mode.***

The SYS-PRM mode screen appears.

24202-A0-00

Step 3 ***Select the parameter group.***

Press F1 *(AXIS) to select the axis parameter.*
The current setting for PRM100 (Robot type) appears on the screen.

24203-A0-00

Step 4 ***Display PRM112 (payload).***

Press the ▲ ▼ keys to scroll up or down the parameter list and select the parameter you want to set.

22204-A0-00

Step 5 ***Set the parameter.***

Enter the parameter value with the number keys and press ⏎.

The parameter setting range is shown on the bottom line of the screen. When setting is complete, the cursor moves back to the beginning of the parameter data.

▶ **Step 1** **Initial menu screen**

```
[MENU]
select menu

1EDIT 2OPRT 3SYS 4MON
```

▶ **Step 2** **SYS (system) mode screen**

```
[SYS]
select menu

1PRM 2B. UP 3INIT 4next
```

▶ **Step 3** **Selecting the parameter group.**

```
[SYS-PRM]
select menu

1AXIS 2DATA 3SYS1 4SYS2
```

```
[SYS-PRM-AXIS]
PRM100 = 4150
robot type
read only
```

▶ **Step 4-5** **Setting the PRM112 (payload)**

```
[SYS-PRM-AXIS]
PRM112 = 10_ [Kg]
payload
range 0→MAX
```

```
[SYS-PRM-AXIS]
PRM112 = 10 [Kg]
payload
range 0→MAX
```

7.2 Maximum speed setting

In operation of a single-axis robot with a long stroke ball screw, resonance of the ball screw may occur. In this case, the maximum speed must be reduced to an appropriate level. The maximum speed can be reduced by lowering the SPEED setting in automatic operation or by programming.
Use the desired method that matches your application.
If the maximum speed does not reach a hazardous level, reducing the speed is unnecessary even when a robot has a long stroke axis.

CAUTION

Do not operate the robot if the ball screw is vibrating. The ball screw may otherwise wear out prematurely.

NOTE

For details about maximum speed setting in response to the stroke length, see "1. Robot specifications" in Chapter 5.

7.3 Duty

To achieve maximum service life for the single-axis robots, the robot must be operated within the allowable duty (50%).
The duty is calculated as follows:

$$\text{Duty (\%)} = \frac{\text{Operation time}}{\text{Operation time+ Non-operation time}} \times 100$$

If the robot duty is too high, an error such as "overload" or "overheat" occurs. In this case, increase the stop time to reduce the duty.

Chapter 3 Periodic inspection

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3. Maintenance parts 3-6
3.1 Consumable parts 3-6
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3.2.1 Single-axis robot cables 3-7
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1. Before beginning work

Periodic inspection and maintenance are essential to ensure safe and efficient operation of YAMAHA robots. The periodic inspection of the FLIP-XC series consists of "daily inspection", "three-month inspection", "six-month inspection", and "three-year inspection".
The daily inspection must be carried out before starting the operation and after completion of the day's work. For details about inspection items, see "2. List of inspection items".
The periodic inspection procedures are described in the separate Maintenance Manual for FLIP-XC series.
Before beginning the work, thoroughly read the safety precautions described below and the Safety Instructions to strictly observe the instructions.

■ Safety precautions

DANGER

IF THE INSPECTION OR MAINTENANCE PROCEDURE CALLS FOR OPERATION OF THE ROBOT, STAY OUT OF THE WORKING AREA OF THE ROBOT DURING OPERATION. KEEP WATCHING THE ROBOT MOVEMENT AND SURROUNDING AREA SO THAT THE OPERATOR CAN PRESS THE EMERGENCY STOP BUTTON IF ANY DANGER OCCURS.

WARNING

- WHEN THE ROBOT DOES NOT NEED TO BE OPERATED DURING ADJUSTMENT OR MAINTENANCE, ALWAYS TURN OFF THE CONTROLLER AND THE EXTERNAL SWITCH BOARD.
- NEVER TOUCH INTERNAL PARTS OF THE CONTROLLER.
- WHEN ONLY MAKING ELECTRICAL INSPECTIONS AND REQUIRING NO MECHANICAL MOVEMENT OF THE ROBOT, KEEP THE EMERGENCY STOP BUTTON PRESSED.
- BE SURE TO USE THE LUBRICANT SPECIFIED BY YOUR DISTRIBUTOR.
- BE SURE TO USE THE PARTS SPECIFIED BY YOUR DISTRIBUTOR WHEN REPLACING PARTS. TAKE SUFFICIENT CARE NOT TO ALLOW ANY FOREIGN MATTER TO CONTAMINATE THEM DURING ADJUSTMENT, PARTS REPLACEMENT OR REASSEMBLY.
- DO NOT MODIFY ANY PARTS ON THE ROBOT OR CONTROLLER. MODIFICATION MAY RESULT IN UNSATISFACTORY SPECIFICATIONS OR THREATEN OPERATOR SAFETY.
- WHEN ADJUSTMENT OR MAINTENANCE IS COMPLETE, RETIGHTEN THE BOLTS AND SCREWS SECURELY.
- DURING ROBOT ADJUSTMENT OR MAINTENANCE, PLACE A SIGN INDICATING THAT THE ROBOT IS BEING ADJUSTED OR SERVICED, TO PREVENT OTHERS FROM TOUCHING THE CONTROL KEYS OR SWITCHES. PROVIDE A LOCK ON THE SWITCH KEYS OR ASK SOMEONE TO KEEP WATCH AS NEEDED.

CAUTION

- Before starting each adjustment work, thoroughly read this Chapter to fully understand its contents.
- Post a sign stating "UNDER WORK" to prevent the controller power switch, programming box/handy terminal, or operation panel from being operated by other work person.
- If the safeguard enclose is not prepared immediately after the installation work, stretch a rope or chain around the robot movable area to use this area as a safeguard enclosure. Additionally, strictly observe the following cautions.
  1. Columns should not move easily.
  2. Rope or chain is legible from surroundings.
  3. Post a sign stating "ENTRY PROHIBITED UNDER WORK" to prevent work personal other than those in charge of robot adjustment work from entering the robot movable area.
- When checking the operation after completion of the adjustment, see "4.5.1 Trial operation" in the Safety Instructions.
- Be sure to wear safety gloves before starting the installation work. If you touch any steel material part by bare hand, this may cause rust.
- For details about cautions on controller, see the User's Manual for controller.

When applying grease to the ball screws and linear guide, take the following precautions.

WARNING

PRECAUTIONS WHEN HANDLING GREASE:

- INFLAMMATION MAY OCCUR IF THIS GETS IN THE EYES. BEFORE HANDLING THE GREASE, WEAR YOUR SAFETY GOGGLES TO ENSURE THE GREASE WILL NOT COME IN CONTACT WITH THE EYES.
- INFLAMMATION MAY OCCUR IF THE GREASE COMES INTO CONTACT WITH SKIN. BE SURE TO WEAR PROTECTIVE GLOVES TO PREVENT CONTACT WITH SKIN.
- DO NOT TAKE ORALLY OR EAT. (EATING WILL CAUSE DIARRHEA AND VOMITING.)
- HANDS AND FINGERS MIGHT BE CUT WHEN OPENING THE CONTAINER, SO USE PROTECTIVE GLOVES.
- KEEP OUT OF THE REACH OF CHILDREN.
- DO NOT HEAT THE GREASE OR PLACE NEAR AN OPEN FLAME SINCE THIS COULD LEAD TO SPARKS AND FIRES.

EMERGENCY TREATMENT:

- IF GREASE GETS IN THE EYES, WASH LIBERALLY WITH PURE WATER FOR ABOUT 15 MINUTES AND CONSULT A PHYSICIAN FOR TREATMENT.
- IF GREASE COMES IN CONTACT WITH THE SKIN, WASH AWAY COMPLETELY WITH SOAP AND WATER.
- IF TAKEN INTERNALLY, DO NOT INDUCE VOMITING BUT PROMPTLY CONSULT A PHYSICIAN FOR PROPER TREATMENT.

WARNING

CAUTIONS ON GREASE HANDLING

- IT IS REQUIRED BY LAW TO PROPERLY TREAT THE GREASE. TREAT THE GREASE APPROPRIATELY ACCORDING TO THE LAWS AND REGULATIONS.
- DO NOT APPLY ANY PRESSURE TO THE EMPTY CONTAINER. IF ANY PRESSURE IS APPLIED, THIS MAY CAUSE THE CONTAINER TO BURST.
- DO NOT WELD, HEAT UP, DRILL, OR CUT THE CONTAINER. DOING SO MAY CAUSE RESIDUAL GREASE TO IGNITE IN ASSOCIATION WITH EXPLOSION.

WARNING

WHEN THE BRAKE OF THE VERTICAL AXIS IS RELEASED, THE SLIDER AXIS MAY DROP, LEADING TO HAZARDOUS SITUATION. WHEN APPLYING THE GREASE TO THE VERTICAL AXIS PARTS, DO NOT RELEASE THE BRAKE.

2. List of inspection items

WARNING

ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO INSPECT THE ITEMS THAT NEED TO REMOVE THE COVER WHILE REFERRING TO THE SEPARATE MAINTENANCE MANUAL FOR FLIP-XC SERIES.

■ Inspection to be performed with the controller turned off

●: Implementation

Checkpoint	Procedure	Daily	Three-month	Six-month	Three-year	Remarks
Cables	• Check for damage, dent and excessively tight bends.	●				• Make the adjustment so that any stress is not applied to the cables. • If any damage is found, replace the defective cable according to the conditions.
Shutter	• Check for scratches, dents, and excessively tight bends.	●				• For details about how to adjust the looseness, see "1. Adjusting the shutter looseness" in Chapter 3 of the Maintenance Manual. • For details about how to replace the shutter, see "1. Replacing the shutter" in Chapter 4 of the Maintenance Manual.
	• Check for looseness.		●			• For details about how to adjust the looseness, see "1. Adjusting the shutter looseness" in Chapter 3 of the Maintenance Manual.
	• Check for flow-up (clearance).	●	●			
Top surface of shutter close to stop point	• Check for stripes caused by contamination.	●				• Wipe off the contamination with a cloth rag moistened with alcohol cleaning agent. • If this trouble occurs frequently, contact your distributor.
Roller for shutter	• Check the entire upper surface of the shutter for black stripe.	●				• If the roller is contaminated, wipe it with a cloth rag. • If the roller is scratched, replace it according to the conditions.
Slider	• Check for unusual wear or breakage.			●		• If the slider is worn out, adjust the mating material so that the interference with the slider is eliminated. • If the slider is broken, contact your distributor.
Motor	• Check for unusual vibration and noise, and for abnormal temperature rise.	●				• Check with the load factor monitor that the load factor is 100% or less. (*1) • For details about how to replace the motor, see "2. Replacing the motor" in Chapter 4 of the Maintenance Manual.
Bolt and screw on exterior of robot body	• Check for looseness.		●			• Retighten the bolts and screws. (See the Table below.) (*2)
Controller	• Check the terminal outside the controller for looseness.		●			• If any faulty part is found, make the adjustment.
	• Check if connectors are loose.		●			
Linear guide	• Check for dirt or contamination.		●			• Clean the linear guide and apply the grease.
	• Check for dried part (insufficient grease).		●			• If the linear guide is dried or if the grease is insufficient, apply the grease.
	• Check for play.			●		• Retighten the bolts and screws. (See the Table below.) (*2) — If the trouble is not solved, contact your distributor.
	• Check for vibration during operation.			●		• Retighten the drive unit or axis installation bolts.
	• Check for backlash due to wear.			●	●	• Contact your distributor.
	• Grease application			●		• Recommended grease Clean room robots: LG2 (NSK) • See "3. Applying grease" in Chapter 2 of the Maintenance Manual.

Checkpoint	Procedure	Daily	Three-month	Six-month	Three-year	Remarks	
Ball screw (screw/nut)	• Check for unusual vibration or noise.	●				• If any trouble is found, contact your distributor.	
	• Check for dirt or contamination.		●			• Clean the linear guide and apply the grease.	
	• Check for dried part (insufficient grease).		●			• If the linear guide is dried or if the grease is insufficient, apply the grease.	
	• Check for play.			●		• Retighten the bolts and screws. (See the Table below.) (*2)	If the trouble is not solved, contact your distributor.
	• Check for vibration during operation.			●		• Retighten the drive unit or axis installation bolts.	
	• Check for backlash due to wear.			●	●	• Contact your distributor.	
	• Grease application			●		• Recommended grease Clean room robots: LG2 (NSK) • See "3. Applying grease" in Chapter 2 of the Maintenance Manual.	
Insert	• Check that the positioning is correct during operation. • Check for unusual noise during operation.			●		• For details about how to replace the insert, see "3. Replacing the insert" in Chapter 4 of the Maintenance Manual.	

■ Inspection to be performed with the controller turned on

●: Implementation

Checkpoint	Procedure	Daily	Three-month	Six-month	Three-year	Remarks
Safety enclosure	• Check if the safety enclosure is in place.	●				
	• Check if emergency stop is triggered when the door is opened.	●				
	• Check if warning labels are affixed at the entrance and clearly visible.	●				
Emergency stop device	• Press the emergency stop button to check if it works.	●				
Robot movement	• Check for abnormal movement and excessive vibration and noise.	●				• Contact your distributor.
Z-axis brake operation (*3)	• Check if the brake works to stop the Z-axis from dropping more than 3mm from the stationary point.	●				• Contact your distributor.
Cooling fan on the rear of the controller	• Check that the fan rotates.		●			
	• Check if any foreign object blocks the fan.		●			
	• Check for unusual noise during rotation.		●			• Visually check the fan. If any foreign object is found, remove it. • If unusual noise is heard even when there is no foreign object, contact your distributor.
	• Check the fan cover for contamination.		●			• Remove the fan cover and clean it.

*1: Some robot controller models cannot monitor the load factor.

*2: Bolt tightening torque

Bolt size	Tightening torque (kgf•cm)	Tightening torque (N•m)
M3 button head bolt	14	1.4
M3	20	2.0
M4	46	4.5
M5	92	9.0
M6	156	15.3
M8	380	37
M10	720	71
M12	1310	128

*3: Visually check the tightening torque from the outside of the safeguard enclosure with the emergency stop switch pressed and the controller power turned off.

3. Maintenance parts

3.1 Consumable parts

C4L/C4LH

Part name	Part number		Remarks
Shutter	KDF-M229J-xxx	SHUTTER 1	50st to 400st
Insert	KDC-M2243-xxx	INSERT	Coupling resin part
Shutter roller	KDF-M22LM-xxx	ROLLER,ASSY	Inner roller
Shutter roller	KDF-M224M-xxx	ROLLER,ASSY	Outer roller

C5L/C5LH

Part name	Part number		Remarks
Shutter	KDG-M229J-xxx	SHUTTER 1	50st to 800st
Insert	KDD-M2243-xxx	INSERT	Coupling resin part
Shutter roller	KDF-M22LM-xxx	ROLLER,ASSY	Inner roller
Shutter roller	KDG-M224M-xxx	ROLLER,ASSY	Outer roller

C6L

Part name	Part number		Remarks
Shutter	KDE-M229J-xxx	SHUTTER 1	50st to 800st
Insert	KDD-M2243-xxx	INSERT	Coupling resin part
Shutter roller	KDF-M22LM-xxx	ROLLER,ASSY	Inner roller
Shutter roller	KDF-M224M-xxx	ROLLER,ASSY	Outer roller

3.2 Robot cables

3.2.1 Single-axis robot cables

■ Cables for ERCD

Cable type	Set model number	Individual part model number	
Standard cable	–	Composite cable	KX1-M4751- ☐ 0
Flexing cable	–	Composite cable	KX1-M4752- ☐ 0

■ Cables for TS-X

Cable type	Set model number	Individual part model number	
Standard cable	KBY-M4710- ☐ 0	Signal cable	KBY-M4751- ☐ 0
		Power cable	KX7-M4752- ☐ 0
Flexing cable	KBY-M4720- ☐ 0	Signal cable	KBY-M4755- ☐ 0
		Power cable	KX7-M4752- ☐ 0

■ Cables for SR1-X

Cable type	Set model number	Individual part model number	
Standard cable	KX7-M4710- ☐ 0	Signal cable	KX7-M4751- ☐ 1
		Power cable	KX7-M4752- ☐ 0
Flexing cable	KX7-M4720- ☐ 0	Signal cable	KX7-M4755- ☐ 0
		Power cable	KX7-M4752- ☐ 0

■ Cables for RDX (robot with brake)

Cable type	Set model number	Individual part model number	
Standard cable	KBH-M4720- ☐ B	Signal cable	KBH-M4753- ☐ 0
		Power cable	KBH-M4752- ☐ 0
		ORG, BK cable	KBH-M4421-00
Flexing cable	KBH-M4740- ☐ B	Signal cable	KBH-M4757- ☐ 0
		Power cable	KBH-M4752- ☐ 0
		ORG, BK cable	KBH-M4421-00

■ Cables for RDX (robot without brake)

Cable type	Set model number	Individual part model number	
Standard cable	KBH-M4710- ☐ A	Signal cable	KBH-M4751- ☐ 0
		Power cable	KBH-M4752- ☐ 0
		I/O connector	KBH-M4420-00
Flexing cable	KBH-M4730- ☐ A	Signal cable	KBH-M4756- ☐ 0
		Power cable	KBH-M4752- ☐ 0
		I/O connector	KBH-M4420-00

3.2.2 Multi-robot cables

■ Cables for single-axis multi-robot

Connection controller : RCX240

Cable type	Cable model number
Flexing cable	KX7-M4754- ☐ 0

■ Cables for two-axis multi-robot

Connection controller : RCX221/222/240

Cable type	Robot combination		Cable model number
	1st axis	2nd axis	
Flexing cable	FLIP-XC	FLIP-XC	KX7-M4753- ☐ 1

Connection controller : RCX221/240

Cable type	Robot combination		Cable model number
	1st axis	2nd axis	
Flexing cable	PHASER	FLIP-XC	KAU-M4754- ☐ 2
	FLIP-XC	PHASER	KAU-M4756- ☐ 2

The number in ☐ shown in the model number has the following meaning.

Number in ☐	Cable length
1 *	1m
3	3.5m
5	5m
A	10m

* Cables for ERCD only

Chapter 4 Troubleshooting

Contents

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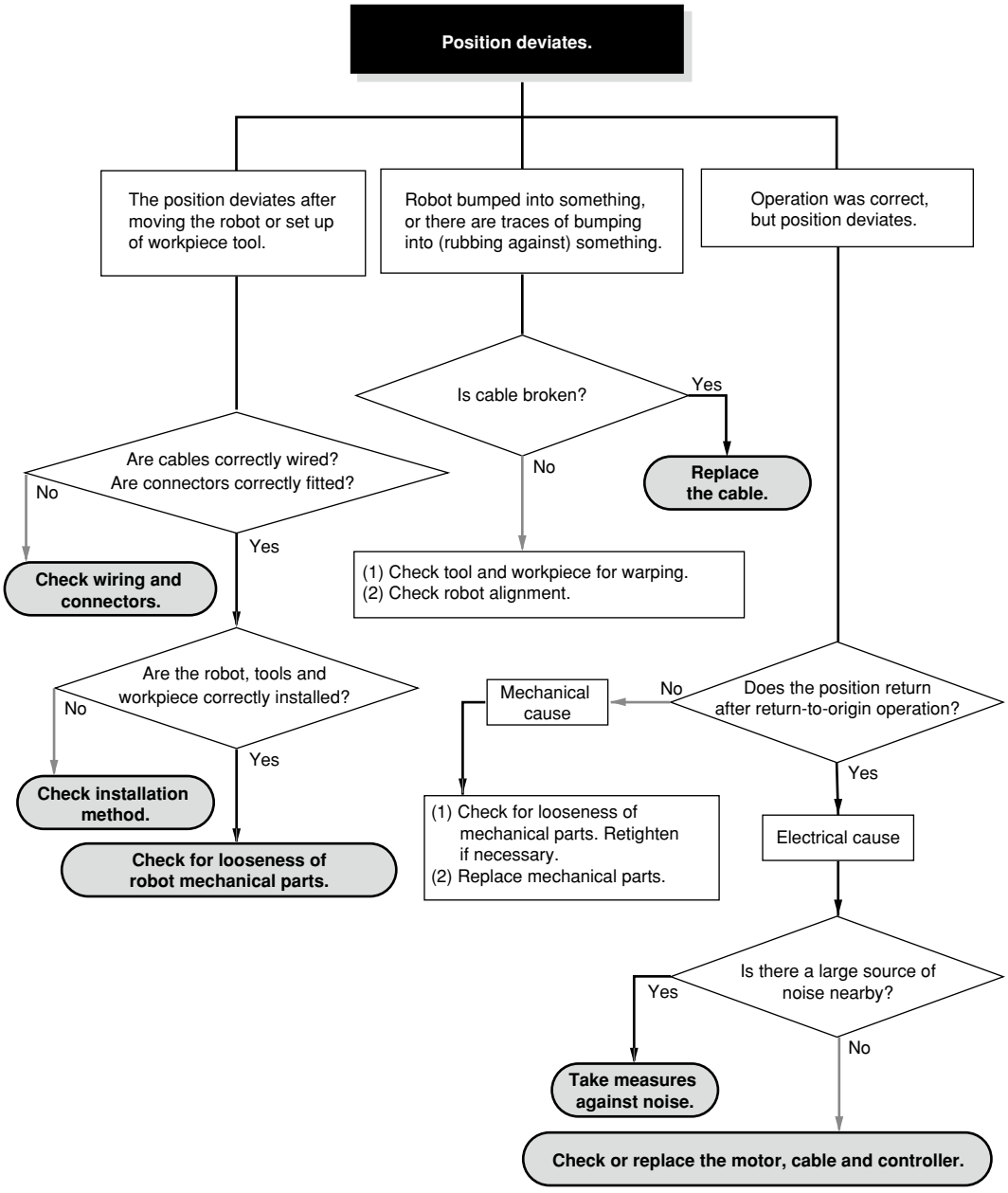
1.2 Feedback error 4-2

1. If you suspect trouble

If an error such as a positioning error or feedback error occurs, check the following points to find the solution before you determine the robot or controller has malfunctioned. If the trouble still exists even after checking these points, please contact your distributor with a detailed description of the trouble.

1.1 Positioning error

Positioning error


Position deviates.
The position deviates after moving the robot or set up of workpiece tool.
Robot bumped into something, or there are traces of bumping into (rubbing against) something.
Operation was correct, but position deviates.
Is cable broken?
Yes
No
Replace the cable.
Are cables correctly wired?
Are connectors correctly fitted?
No
Yes
Check wiring and connectors.
(1) Check tool and workpiece for warping.
(2) Check robot alignment.
Are the robot, tools and workpiece correctly installed?
No
Yes
Check installation method.
Check for looseness of robot mechanical parts.
Mechanical cause
No
Does the position return after return-to-origin operation?
Yes
(1) Check for looseness of mechanical parts. Retighten if necessary.
(2) Replace mechanical parts.
Electrical cause
Is there a large source of noise nearby?
Yes
No
Take measures against noise.
Check or replace the motor, cable and controller.

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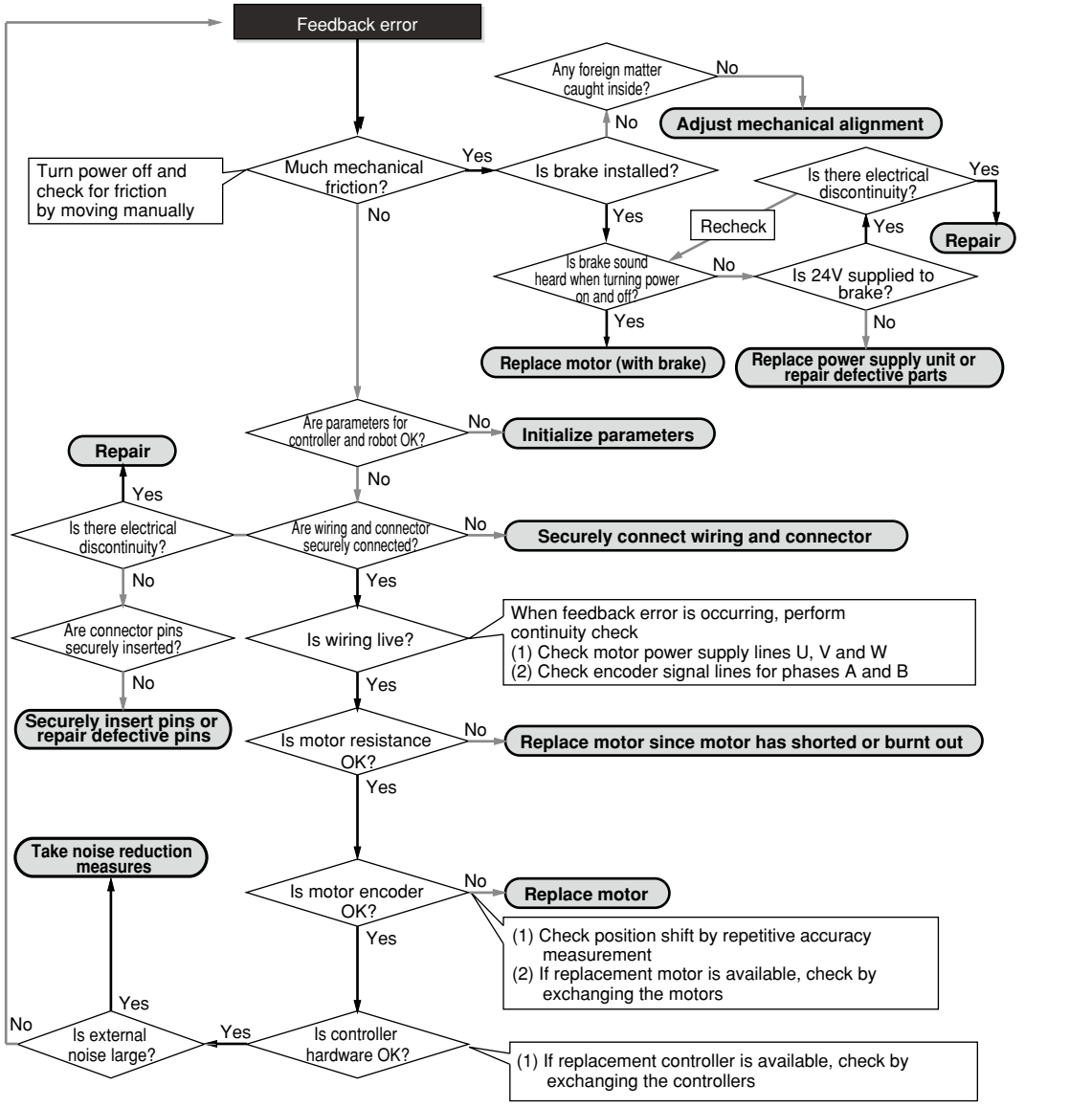
1.2 Feedback error

Feedback error



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Chapter 5 Specifications

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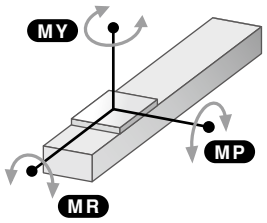
1. Robot specifications

1.1 C4L/C4LH

Specifications

		C4L		C4LH
AC servo motor output (W)		30		
Repeatability(mm) Note 1		±0.02		
Position detector		Resolvers Note 2		
Resolution (Pulse/rotation)		16384		
Deceleration mechanism		Ball screw ϕ8 (Class C10)		
Ball screw lead (mm)		12	6	2
Maximum speed (mm/sec)		720	360	120
Maximum payload (kg)	Horizontal	4.5	6	6
	Vertical	1.2	2.4	7.2
Rated thrust (N)		32	64	153
Stroke (mm)		50 to 400		
Linear guide type		2 rows of gothic arch grooves × 1 rail		
Overall length (mm)	Horizontal	Stroke+205		
	Vertical	Stroke+240		
Maximum dimensions of cross section of main unit (mm)		W45×H53		
Cable length (m)		Standard: 3.5 / Option: 5,10		
Controller		ERCD		SR1-X, TS-X, RCX222, RCX240
Robot driver		–		RDX-05
Degree of cleanliness (ISO) Note 3		CLASS3		
Intake air (Nℓ/min) Note 4		50	30	15

Static loading moment



MY	MP	MR
15	19	18

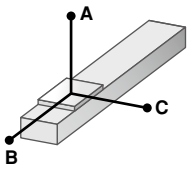
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. ISO14644-1 class 3 or its equivalent. Suction blower is used.
Note 4. The required suction rate may vary depending on the operating conditions and operating environment.

Allowable overhang

Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 300mm when calculating the service life.

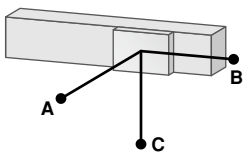
Horizontal installation



C4L		A	B	C
Lead 12	2kg	429	87	179
	4.5kg	219	32	74
Lead 6	3kg	511	58	135
	6kg	336	26	62
Lead 2	3kg	1571	58	142
	6kg	751	27	66

C4LH		A	B	C
Lead 12	2kg	339	90	174
	4.5kg	169	37	72
Lead 6	3kg	352	58	133
	6kg	234	27	62
Lead 2	3kg	1105	59	142
	6kg	520	27	66

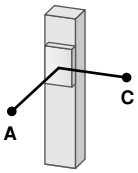
Wall installation



C4L		A	B	C
Lead 12	2kg	145	52	368
	4.5kg	46	0	139
Lead 6	3kg	103	22	370
	6kg	27	0	185
Lead 2	3kg	109	23	1150
	6kg	27	0	420

C4LH		A	B	C
Lead 12	2kg	136	72	295
	4.5kg	44	20	111
Lead 6	3kg	101	41	254
	6kg	27	10	127
Lead 2	3kg	110	41	805
	6kg	28	10	290

Vertical installation

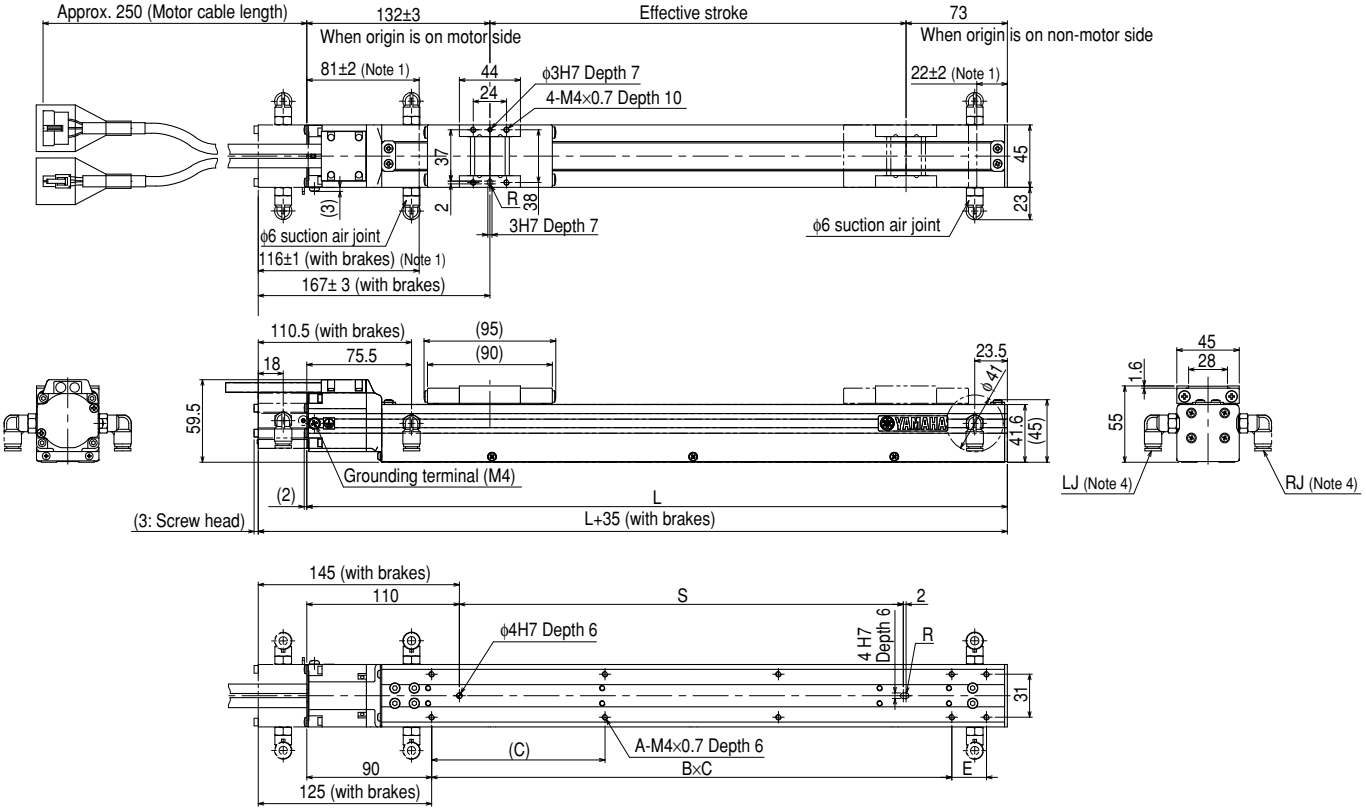


C4L		A	C
Lead 12	1.2kg	121	122
Lead 6	2.4kg	52	54
Lead 2	3kg	37	39
	7.2kg	0	0

C4LH		A	C
Lead 12	1.2kg	118	118
Lead 6	2.4kg	52	54
Lead 2	3kg	38	39
	7.2kg	0	0

(Unit: mm)

Dimensions



23501-B1-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R30.
Note 3. Weight of models with no brake. The weight of brake-attached models is 0.2kg heavier than the models with no brake shown in the table.
Note 4. Either right or left can be selected for the installation direction for the ϕ6 intake air joint. (The left side is the standard.)

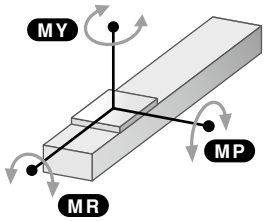
Effective stroke	50	100	150	200	250	300	350	400
L	255	305	355	405	455	505	555	605
A	4	6	6	8	8	10	10	10
B	1	2	2	2	2	3	3	4
C	150	100	125	125	125	125	125	125
E	0	0	0	50	100	25	75	0
S	70	120	170	220	270	320	370	420
Weight (kg) Note 3	1.4	1.5	1.7	1.8	2.0	2.1	2.3	2.4

1.2 C5L/C5LH

Specifications

		C5L		C5LH
AC servo motor output (W)		30		
Repeatability(mm) Note 1		±0.02		
Position detector		Resolvers Note 2		
Resolution (Pulse/rotation)		16384		
Deceleration mechanism		Ball screw ϕ12 (Class C10)		
Ball screw lead (mm)		20	12	6
Maximum speed (mm/sec) Note 3		1000	800	400
Maximum payload (kg)	Horizontal	3	5	9
	Vertical	–	1.2	2.4
Rated thrust (N)		19	32	64
Stroke (mm)		50 to 800		
Linear guide type		2 rows of gothic arch grooves × 1 rail		
Overall length (mm)	Horizontal	Stroke+201.5		
	Vertical	Stroke+236.5		
Maximum dimensions of cross section of main unit (mm)		W55×H52		
Cable length (m)		Standard: 3.5 / Option: 5,10		
Controller		ERCD		SR1-X, TS-X, RCX222, RCX240
Robot driver		–		RDX-05
Degree of cleanliness (ISO) Note 4		CLASS3		
Intake air (Nℓ/min) Note 5		80	50	30

Static loading moment



MY	MP	MR
30	34	40

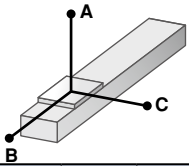
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 600mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. ISO14644-1 class 3 or its equivalent. Suction blower is used.
Note 5. The required suction rate may vary depending on the operating conditions and operating environment.

Allowable overhang

Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

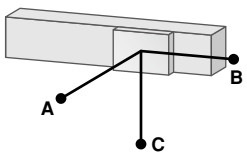
Horizontal installation



C5L		A	B	C
Lead 20	1kg	1584	324	745
	3kg	699	104	251
Lead 12	2kg	1166	159	406
	5kg	551	59	155
Lead 6	3kg	1194	104	294
	9kg	624	31	89

C5LH		A	B	C
Lead 20	1kg	1099	324	645
	3kg	488	104	241
Lead 12	2kg	916	159	398
	5kg	436	60	152
Lead 6	3kg	1194	105	294
	9kg	624	31	89

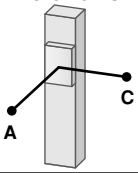
Wall installation



C5L		A	B	C
Lead 20	1kg	679	303	1505
	3kg	215	87	605
Lead 12	2kg	364	126	1073
	5kg	123	28	438
Lead 6	3kg	259	72	354
	9kg	50	0	154

C5LH		A	B	C
Lead 20	1kg	602	303	950
	3kg	197	87	432
Lead 12	2kg	347	141	800
	5kg	119	44	355
Lead 6	3kg	259	87	950
	9kg	50	15	385

Vertical installation

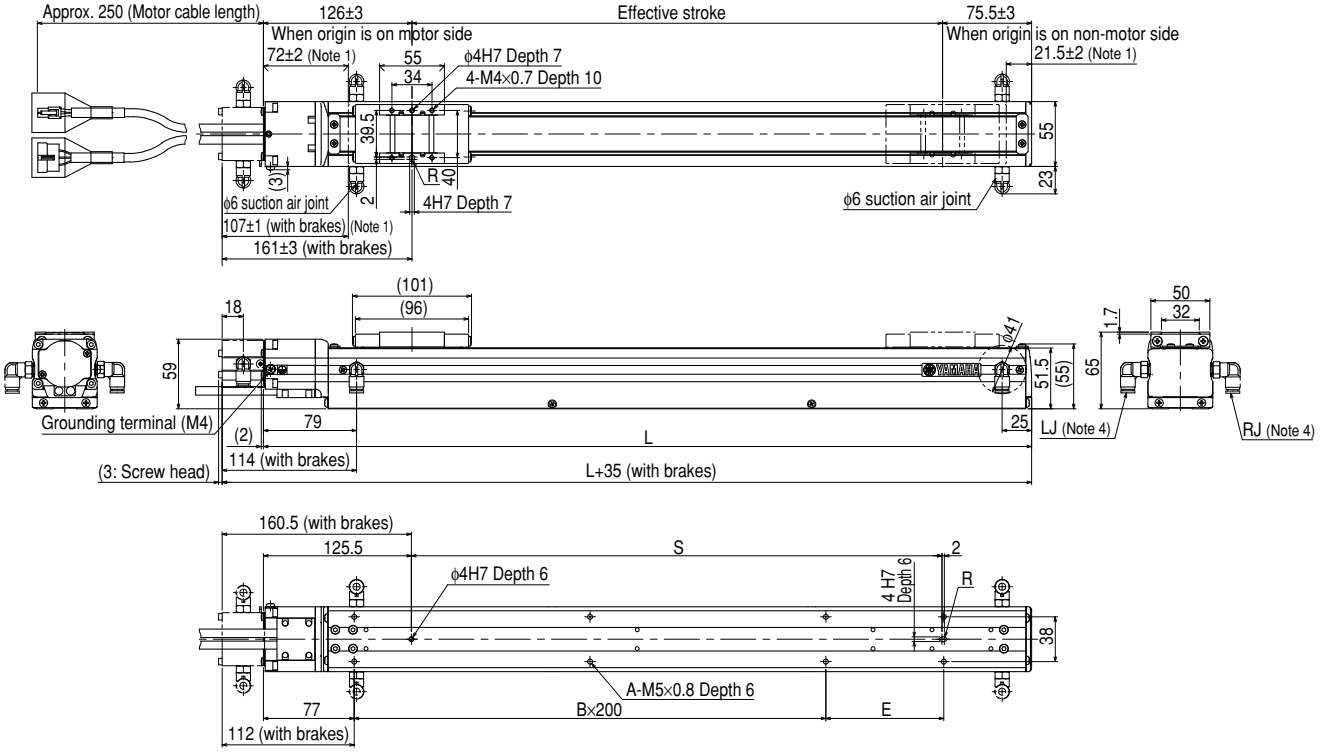


C5L		A	C
Lead 12	1.2kg	246	245
Lead 6	2.4kg	110	110

C5LH		A	C
Lead 12	1.2kg	240	239
Lead 6	2.4kg	109	110

(Unit: mm)

■ Dimensions



23501-B2-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R30.
Note 3. Weight of models with no brake. The weight of brake-attached models is 0.2kg heavier than the models with no brake shown in the table.
Note 4. Either right or left can be selected for the installation direction for the ϕ6 intake air joint. (The left side is the standard.)

Effective stroke		50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
L		251.5	301.5	351.5	401.5	451.5	501.5	551.5	601.5	651.5	701.5	751.5	801.5	851.5	901.5	951.5	1001.5
A		4	4	4	6	6	6	6	8	8	8	8	10	10	10	10	12
B		0	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4
E		100	200	200	100	100	200	200	100	100	200	200	100	100	200	200	100
S		50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
Weight (kg) Note 3		1.7	2.0	2.2	2.5	2.7	3.0	3.2	3.4	3.7	3.9	4.2	4.4	4.7	4.9	5.1	5.4
Maximum speed (mm/sec) Note 5	Lead 20	1000													900	800	700
	Speed setting	–													90%	80%	70%
	Lead 12	800												640	560	480	440
	Lead 6	400												320	280	240	220
	Speed setting	–												80%	70%	60%	55%

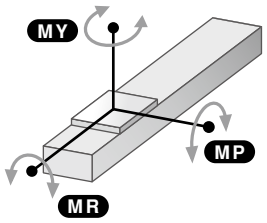
Note 5. When the stroke is longer than 600mm, resonance of the ball screw may occur depending on the operation conditions (critical speed). In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.3 C6L

Specifications

AC servo motor output (W)		60		
Repeatability(mm) Note 1		±0.02		
Position detector		Resolvers Note 2		
Resolution (Pulse/rotation)		16384		
Deceleration mechanism		Ball screw ϕ12 (Class C10)		
Ball screw lead (mm)		20	12	6
Maximum speed (mm/sec) Note 3		1000	800	400
Maximum payload (kg)	Horizontal	10	12	30
	Vertical	–	4	8
Rated thrust (N)		51	85	170
Stroke (mm)		50 to 800		
Linear guide type		2 rows of gothic arch grooves × 1 rail		
Overall length (mm)	Horizontal	Stroke+247.5		
	Vertical	Stroke+282.5		
Maximum dimensions of cross section of main unit (mm)		W65×H56		
Cable length (m)		Standard: 3.5 / Option: 5,10		
Controller		SR1-X, TS-X, RCX222, RCX240		
Robot driver		RDX-05		
Degree of cleanliness (ISO) Note 4		CLASS3		
Intake air (Nℓ/min) Note 5		80	50	30

Static loading moment



MY	MP	MR
35	40	50

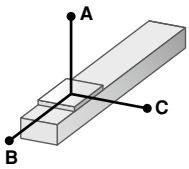
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 600mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. ISO14644-1 class 3 or its equivalent. Suction blower is used.
Note 5. The required suction rate may vary depending on the operating conditions and operating environment.

Allowable overhang

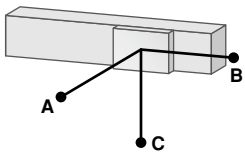
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



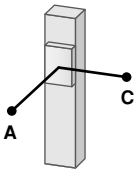
		A	B	C
Lead 20	2kg	433	192	295
	6kg	145	59	104
	10kg	110	33	75
Lead 12	3kg	622	125	336
	8kg	271	41	121
	12kg	214	24	76
Lead 6	5kg	692	73	236
	10kg	372	33	109
	30kg	157	0	25

Wall installation



		A	B	C
Lead 20	2kg	300	174	365
	6kg	83	44	105
	10kg	43	18	71
Lead 12	3kg	291	96	317
	8kg	87	13	110
	12kg	41	0	126
Lead 6	5kg	202	45	237
	10kg	70	5	97
	30kg	0	0	0

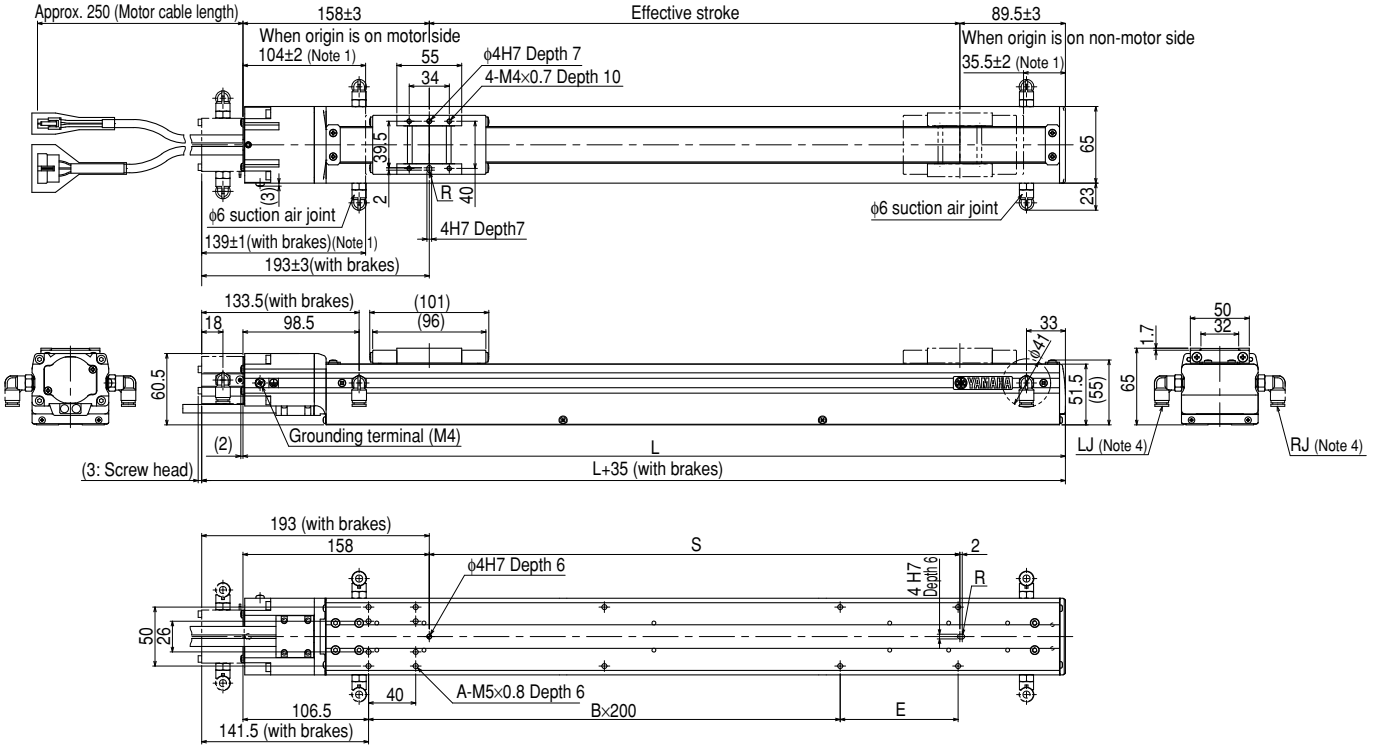
Vertical installation



		A	C
Lead 12	1kg	353	351
	2kg	163	164
	4kg	68	70
Lead 6	2kg	169	170
	4kg	71	73
	8kg	21	24

(Unit: mm)

■ Dimensions



23501-B3-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R30.
Note 3. Weight of models with no brake. The weight of brake-attached models is 0.2kg heavier than the models with no brake shown in the table.
Note 4. Either right or left can be selected for the installation direction for the ϕ6 intake air joint. (The left side is the standard.)

Effective stroke		50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
L		297.5	347.5	397.5	447.5	497.5	547.5	597.5	647.5	697.5	747.5	797.5	847.5	897.5	947.5	997.5	1047.5
A		10	10	10	12	12	12	12	14	14	14	14	16	16	16	16	18
B		0	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4
E		150	200	200	100	100	200	200	100	100	200	200	100	100	200	200	100
S		50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800
Weight (kg) Note 3		2.6	2.9	3.1	3.4	3.7	4.0	4.3	4.6	4.9	5.2	5.4	5.7	6.0	6.3	6.6	6.8
Maximum speed (mm/sec) Note 5	Lead 20	1000													900	800	700
	Speed setting	–													90%	80%	70%
	Lead 12	800												680	600	520	480
	Lead 6	400												340	300	260	240
	Speed setting	–												85%	75%	65%	60%

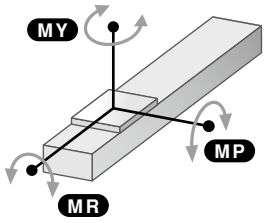
Note 5. When the stroke is longer than 600mm, resonance of the ball screw may occur depending on the operation conditions (critical speed). In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.4 C8

Specifications

AC servo motor output (W)		100		
Repeatability(mm) Note 1		±0.02		
Position detector		Resolvers Note 2		
Resolution (Pulse/rotation)		16384		
Deceleration mechanism		Ball screw ϕ12 (Class C10)		
Ball screw lead (mm)		20	12	6
Maximum speed (mm/sec) Note 3		1000	720	360
Maximum payload (kg)	Horizontal	12	20	40
	Vertical	–	4	8
Rated thrust (N)		84	141	283
Stroke (mm)		150 to 800 (50mm pitch)		
Linear guide type		4 rows of circular arc grooves × 1 rail		
Overall length (mm)	Horizontal	Stroke+320		
	Vertical	Stroke+355		
Maximum dimensions of cross section of main unit (mm)		W80×H75		
Cable length (m)		Standard: 3.5 / Option: 5,10		
Controller		SR1-X, TS-X, RCX222, RCX240		
Robot driver		RDX-05		
Degree of cleanliness Note 4		CLASS10		
Intake air (Nℓ/min) Note 5		30 to 90		

Static loading moment



MY	MP	MR
70	95	110

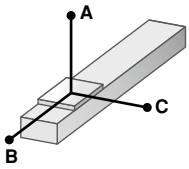
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 550mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. Per 1cf (0.1μm base), when suction blower is used.
Note 5. The necessary intake amount varies depending on the use conditions and environment.

Allowable overhang

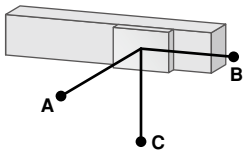
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



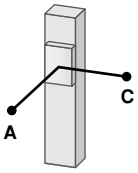
		A	B	C
Lead 20	5kg	245	85	146
	10kg	131	39	69
	12kg	115	31	57
Lead 12	5kg	364	92	192
	10kg	207	43	92
	15kg	144	26	41
	20kg	112	18	40
Lead 6	10kg	406	47	124
	20kg	225	20	54
	30kg	162	11	31
	40kg	168	7	20

Wall installation



		A	B	C
Lead 20	5kg	121	71	211
	10kg	42	24	88
	12kg	29	16	66
Lead 12	5kg	164	78	328
	10kg	62	29	158
	15kg	26	12	83
	20kg	7	4	32
Lead 6	10kg	87	33	353
	20kg	18	6	127
	30kg	0	0	0
	40kg	0	0	0

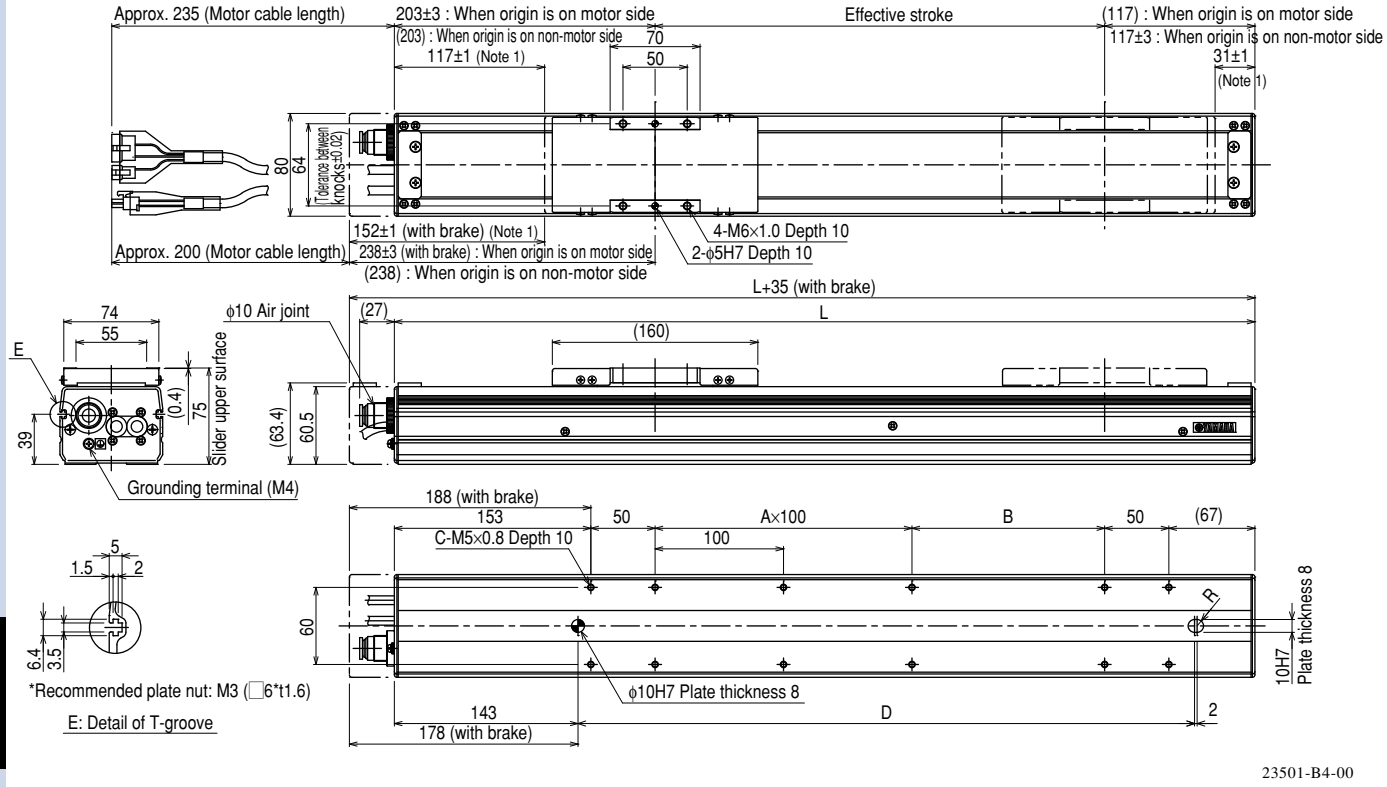
Vertical installation



		A	C
Lead 12	1kg	440	442
	2kg	207	209
	3kg	130	132
	4kg	91	92
Lead 6	2kg	237	238
	4kg	106	96
	6kg	62	62
	8kg	34	40

(Unit: mm)

■ Dimensions



23501-B4-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R50.
Note 3. Weight of models with no brake. The weight of brake-attached models is 0.3kg heavier than the models with no brake shown in the table.

Effective stroke		150	200	250	300	350	400	450	500	550	600	650	700	750	800
L		470	520	570	620	670	720	770	820	870	920	970	1020	1070	1120
A		0	1	1	2	2	3	3	4	4	5	5	6	6	7
B		150	100	150	100	150	100	150	100	150	100	150	100	150	100
C		8	10	10	12	12	14	14	16	16	18	18	20	20	22
D		280	330	380	430	480	530	580	630	680	730	780	830	880	930
Weight (kg) Note 3		3.6	3.9	4.1	4.4	4.7	5.0	5.3	5.6	5.9	6.2	6.4	6.7	7.0	7.3
Maximum speed (mm/sec) Note 4	Lead 20	1000										950	800	700	650
	Speed setting	–										95%	80%	70%	65%
	Lead 12	720									648	540	468	432	360
	Lead 6	360									324	270	234	216	180
	Speed setting	–									90%	75%	65%	60%	50%

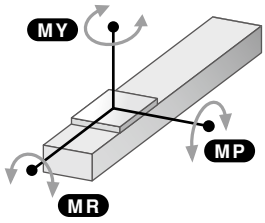
Note 4. When the stroke is longer than 550mm, resonance of the ball screw may occur depending on the operation conditions (critical speed). In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.5 C8L

Specifications

AC servo motor output (W)		100		
Repeatability(mm) Note 1		±0.01		
Position detector		Resolvers Note 2		
Resolution (Pulse/rotation)		16384		
Deceleration mechanism		Ball screw ϕ15 (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec) Note 3		1000	600	300
Maximum payload (kg)	Horizontal	20	40	50
	Vertical	4	8	16
Rated thrust (N)		84	169	339
Stroke (mm)		150 to 1050 (50mm pitch)		
Linear guide type		4 rows of circular arc grooves × 1 rail		
Overall length (mm)	Horizontal	Stroke+325		
	Vertical	Stroke+360		
Maximum dimensions of cross section of main unit (mm)		W80×H75		
Cable length (m)		Standard: 3.5 / Option: 5,10		
Controller		SR1-X, TS-X, RCX222, RCX240		
Robot driver		RDX-05		
Degree of cleanliness Note 4		CLASS10		
Intake air (Nℓ/min) Note 5		30 to 90		

Static loading moment



MY	MP	MR
70	95	110

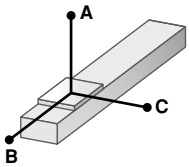
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 650mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. Per 1cf (0.1μm base), when suction blower is used.
Note 5. The necessary intake amount varies depending on the use conditions and environment.

Allowable overhang

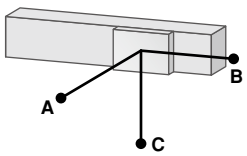
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



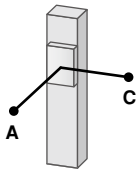
		A	B	C
Lead 20	5kg	259	122	179
	10kg	149	55	89
	15kg	100	33	56
	20kg	95	22	41
Lead 10	10kg	251	61	130
	20kg	127	25	55
	30kg	90	14	31
	40kg	69	8	18
Lead 5	20kg	256	29	76
	30kg	188	16	43
	40kg	96	10	28
	50kg	33	6	18

Wall installation



		A	B	C
Lead 20	5kg	147	100	220
	10kg	53	32	97
	15kg	17	10	39
	20kg	0	0	0
Lead 10	10kg	87	41	197
	20kg	10	4	37
	30kg	0	0	0
	40kg	0	0	0
Lead 5	20kg	24	9	152
	30kg	0	0	0
	40kg	0	0	0
	50kg	0	0	0

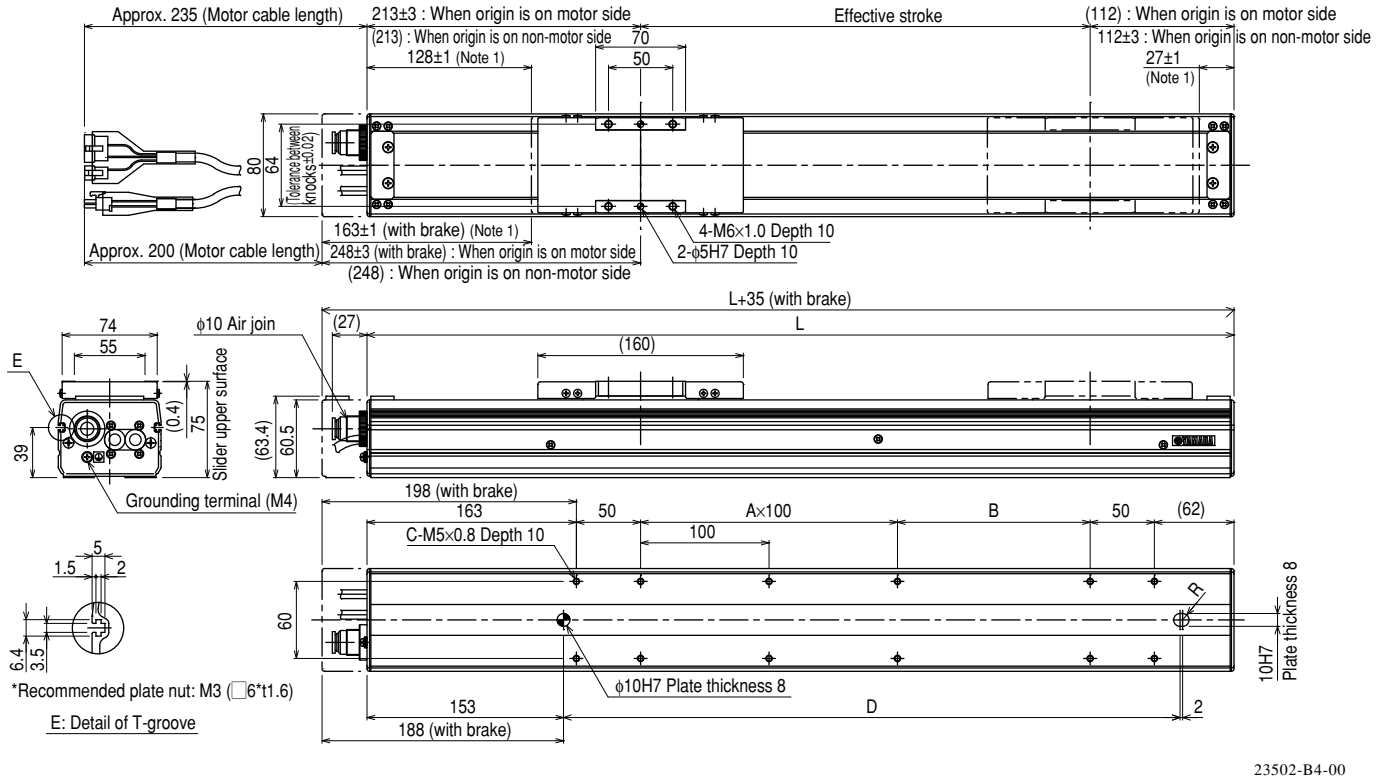
Vertical installation



		A	C
Lead 20	2kg	255	260
	4kg	111	115
Lead 10	2kg	300	302
	4kg	131	133
	6kg	75	77
	8kg	47	49
Lead 5	5kg	113	114
	10kg	37	38
	15kg	12	12
	16kg	9	9

(Unit: mm)

■ Dimensions



Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R50.
Note 3. Weight of models with no brake. The weight of brake-attached models is 0.3kg heavier than the models with no brake shown in the table.

Effective stroke		150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
L		475	525	575	625	675	725	775	825	875	925	975	1025	1075	1125	1175	1225	1275	1325	1375
A		0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9
B		150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150
C		8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26
D		280	330	380	430	480	530	580	630	680	730	780	830	880	930	980	1030	1080	1130	1180
Weight (kg) Note 3		3.9	4.2	4.5	4.8	5.1	5.4	5.7	6.0	6.4	6.7	7.0	7.3	7.6	7.9	8.2	8.5	8.8	9.2	9.5
Maximum speed (mm/sec) Note 4	Lead 20	1000												900	800	700	650	600	550	500
	Speed setting	–												90%	80%	70%	65%	60%	55%	50%
	Lead 10	600											510	450	390	360	330	300	270	240
	Lead 5	300											255	225	195	180	165	150	135	120
	Speed setting	–											85%	75%	65%	60%	55%	50%	45%	40%

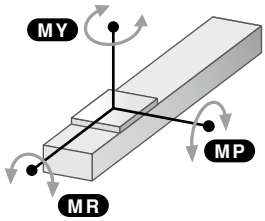
Note 4. When the stroke is longer than 650mm, resonance of the ball screw may occur depending on the operation conditions (critical speed).
In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.6 C8LH

Specifications

AC servo motor output (W)		100		
Repeatability(mm) Note 1		±0.01		
Position detector		Resolvers Note 2		
Resolution (Pulse/rotation)		16384		
Deceleration mechanism		Ball screw ϕ15 (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec) Note 3		1000	600	300
Maximum payload (kg)	Horizontal	30	60	80
Rated thrust (N)		84	169	339
Stroke (mm)		150 to 1050 (50mm pitch)		
Linear guide type		4 rows of circular arc grooves × 1 rail		
Overall length (mm)		Stroke+389		
Maximum dimensions of cross section of main unit (mm)		W80×H75		
Cable length (m)		Standard: 3.5 / Option: 5,10		
Controller		SR1-X, TS-X, RCX222, RCX240		
Robot driver		RDX-05		
Degree of cleanliness Note 4		CLASS10		
Intake air (Nℓ/min) Note 5		30 to 90		

Static loading moment



MY	MP	MR
128	163	143

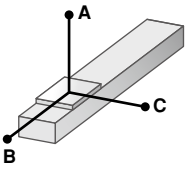
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 600mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. Per 1cf (0.1μm base), when suction blower is used.
Note 5. The necessary intake amount varies depending on the use conditions and environment.

Allowable overhang

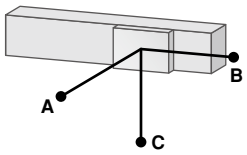
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



		A	B	C
Lead 20	10kg	687	274	200
	20kg	401	125	92
	30kg	338	76	57
Lead 10	20kg	622	137	111
	40kg	472	57	47
	60kg	375	30	25
Lead 5	20kg	1087	148	127
	40kg	844	63	54
	60kg	707	34	29
	80kg	594	20	17

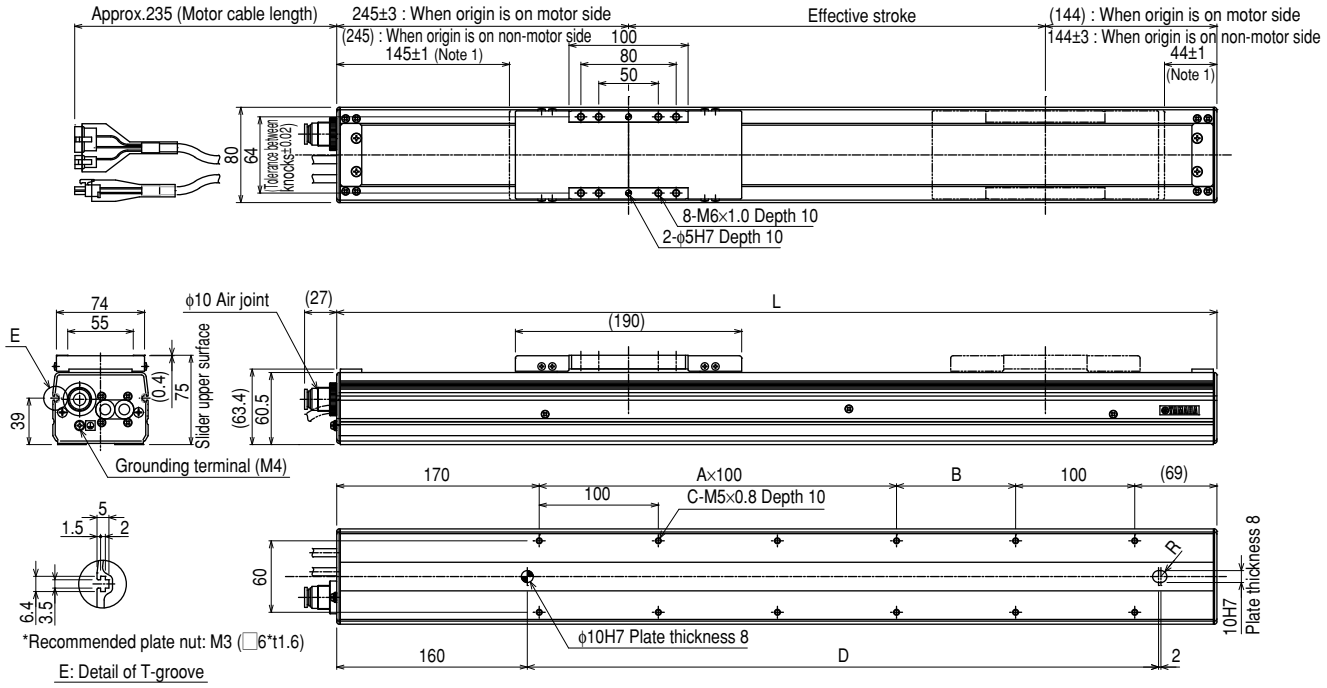
Wall installation



		A	B	C
Lead 20	10kg	163	225	617
	20kg	56	76	302
	30kg	20	27	182
Lead 10	20kg	74	90	517
	40kg	8	11	196
	60kg	–	–	–
Lead 5	20kg	89	104	974
	40kg	15	18	505
	60kg	–	–	–
	80kg	–	–	–

(Unit: mm)

■ Dimensions



Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R50.

Effective stroke		150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
L		539	589	639	689	739	789	839	889	939	989	1039	1089	1139	1189	1239	1289	1339	1389	1439
A		1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10
B		100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100	150	100
C		8	8	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26
D		330	380	430	480	530	580	630	680	730	780	830	880	930	980	1030	1080	1130	1180	1230
Weight (kg)		4.7	5.0	5.3	5.6	5.9	6.2	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	9.3	9.7	10.0	10.3
Maximum speed (mm/sec) Note 3	Lead 20	1000											900	800	700	650	600	550	500	450
	Speed setting	–											90%	80%	70%	65%	60%	55%	50%	45%
	Lead 10	600										510	450	390	360	330	300	270	240	210
	Lead 5	300										255	225	195	180	165	150	135	120	105
	Speed setting	–										85%	75%	65%	60%	55%	50%	45%	40%	35%

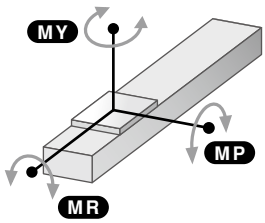
Note 3. When the stroke is longer than 600mm, resonance of the ball screw may occur depending on the operation conditions (critical speed).
In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.7 C10

Specifications

AC servo motor output (W)		100		
Repeatability(mm) Note 1		±0.01		
Position detector		Resolvers Note 2		
Resolution (Pulse/rotation)		16384		
Deceleration mechanism		Ball screw ϕ15 (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec) Note 3		1000	500	250
Maximum payload (kg)	Horizontal	20	40	60
	Vertical	4	10	20
Rated thrust (N)		84	169	339
Stroke (mm)		150 to 1050 (50mm pitch)		
Linear guide type		4 rows of circular arc grooves × 1 rail		
Overall length (mm)	Horizontal	Stroke+283		
	Vertical	Stroke+313		
Maximum dimensions of cross section of main unit (mm)		W104×H85		
Cable length (m)		Standard: 3.5 / Option: 5,10		
Controller		SR1-X, TS-X, RCX222, RCX240		
Robot driver		RDX-05		
Degree of cleanliness Note 4		CLASS10		
Intake air (Nℓ/min) Note 5		30 to 90		

Static loading moment



MY	MP	MR
119	119	105

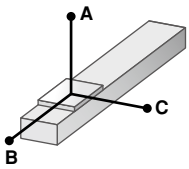
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 700mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. Per 1cf (0.1μm base), when suction blower is used.
Note 5. The necessary intake amount varies depending on the use conditions and environment.

Allowable overhang

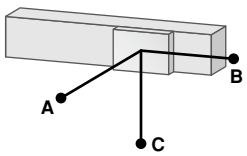
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



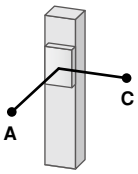
		A	B	C
Lead 20	5kg	1875	530	510
	10kg	1079	247	242
	20kg	628	106	107
Lead 10	15kg	765	156	164
	30kg	425	62	66
	40kg	350	38	42
Lead 5	30kg	960	63	68
	50kg	565	25	28
	60kg	470	16	17

Wall installation



		A	B	C
Lead 20	5kg	496	451	1826
	10kg	218	168	1002
	20kg	78	27	497
Lead 10	10kg	230	170	1036
	20kg	80	29	506
	30kg	30	0	311
Lead 5	10kg	234	170	2716
	20kg	82	29	1206
	30kg	31	0	711

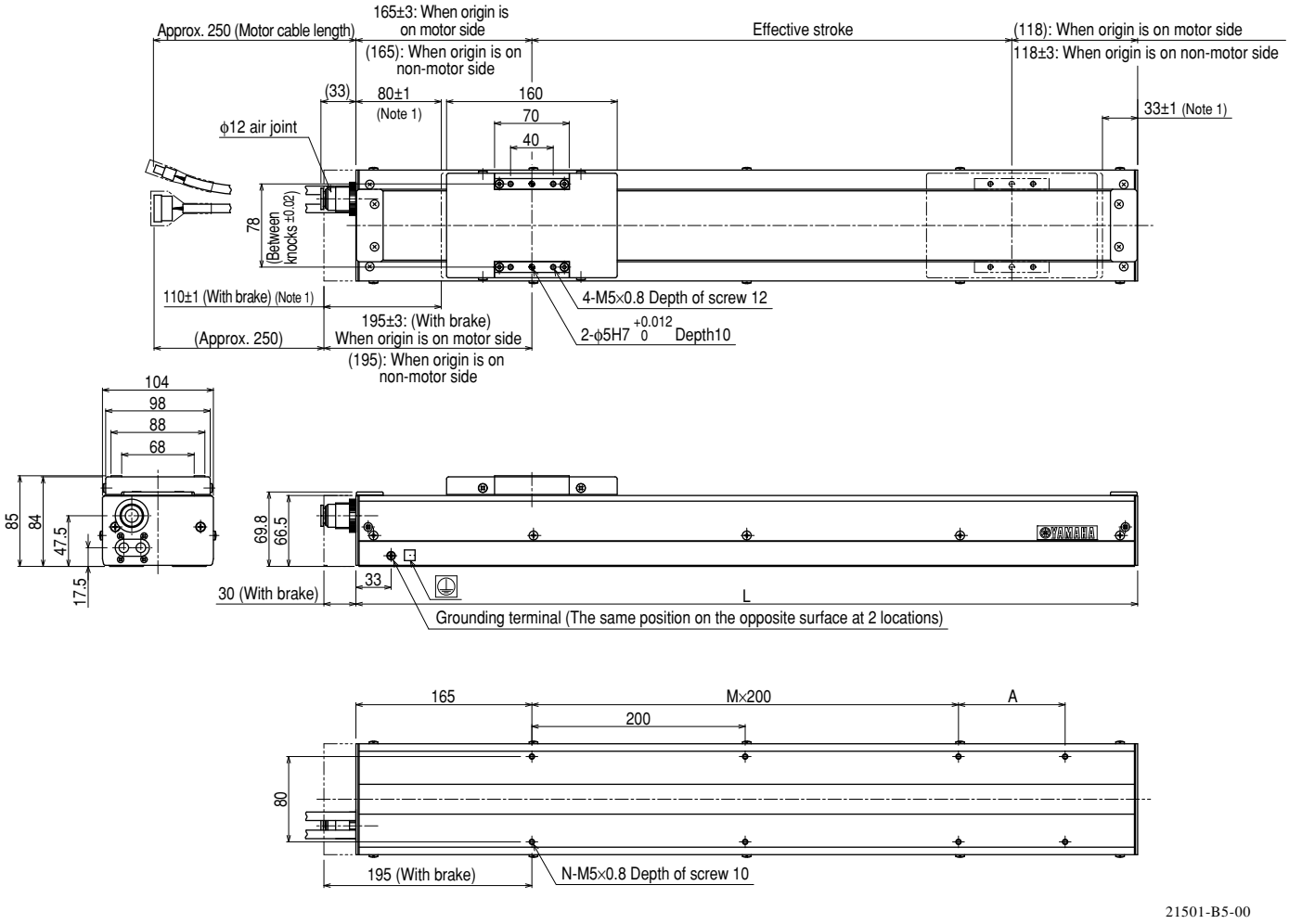
Vertical installation



		A	C
Lead 20	1kg	2461	2492
	2kg	1213	1244
	4kg	585	617
Lead 10	4kg	627	658
	8kg	280	312
	10kg	210	242
Lead 5	10kg	213	244
	15kg	119	151
	20kg	72	104

(Unit: mm)

Dimensions



21501-B5-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R50.
Note 3. Weight of models with no brake. The weight of brake-attached models is 0.4kg heavier than the models with no brake shown in the table.

Effective stroke		150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
L		433	483	533	583	633	683	733	783	833	883	933	983	1033	1083	1133	1183	1233	1283	1333
A		200	50	100	150	200	50	100	150	200	50	100	150	200	50	100	150	200	50	100
M		0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5
N		4	6	6	6	6	8	8	8	8	10	10	10	10	12	12	12	12	14	14
Weight (kg) Note 3		4.4	5.0	5.5	6.1	6.7	7.3	7.8	8.4	9.0	9.6	10.1	10.7	11.3	11.9	12.4	13.0	13.6	14.2	14.7
Maximum speed (mm/sec) Note 4	Lead 20	1000												950	950	750	750	600	600	500
	Lead 10	500												475	475	375	375	300	300	250
	Lead 5	250												237	237	187	187	150	150	125
	Speed setting	–												95%	95%	75%	75%	60%	60%	50%

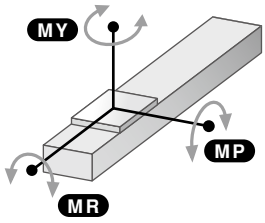
Note 4. When the stroke is longer than 700mm, resonance of the ball screw may occur depending on the operation conditions (critical speed). In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.8 C14

Specifications

AC servo motor output (W)		100		
Repeatability(mm) Note 1		±0.01		
Position detector		Resolvers Note 2		
Resolution (Pulse/rotation)		16384		
Deceleration mechanism		Ball screw ϕ15 (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec) Note 3		1000	500	250
Maximum payload (kg)	Horizontal	30	55	80
	Vertical	4	10	20
Rated thrust (N)		84	169	339
Stroke (mm)		150 to 1050 (50mm pitch)		
Linear guide type		4 rows of circular arc grooves × 2 rail		
Overall length (mm)	Horizontal	Stroke+285		
	Vertical	Stroke+315		
Maximum dimensions of cross section of main unit (mm)		W136×H96		
Cable length (m)		Standard: 3.5 / Option: 5,10		
Controller		SR1-X, TS-X, RCX222, RCX240		
Robot driver		RDX-05		
Degree of cleanliness Note 4		CLASS10		
Intake air (Nℓ/min) Note 5		30 to 90		

Static loading moment



MY	MP	MR
232	233	204

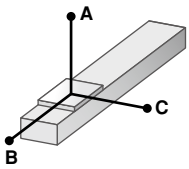
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 700mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. Per 1cf (0.1μm base), when suction blower is used.
Note 5. The necessary intake amount varies depending on the use conditions and environment.

Allowable overhang

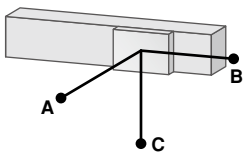
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



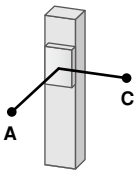
		A	B	C
Lead 20	5kg	2127	1384	968
	15kg	1177	459	425
	30kg	1247	242	291
Lead 10	20kg	1120	349	353
	40kg	857	179	215
	55kg	932	138	182
Lead 5	50kg	2017	250	335
	60kg	1477	134	192
	80kg	1452	106	157

Wall installation



		A	B	C
Lead 20	5kg	1047	968	1553
	15kg	387	264	748
	30kg	206	97	633
Lead 10	20kg	299	180	658
	40kg	127	49	363
	55kg	79	16	296
Lead 5	50kg	233	103	1033
	60kg	75	13	433
	80kg	35	0	242

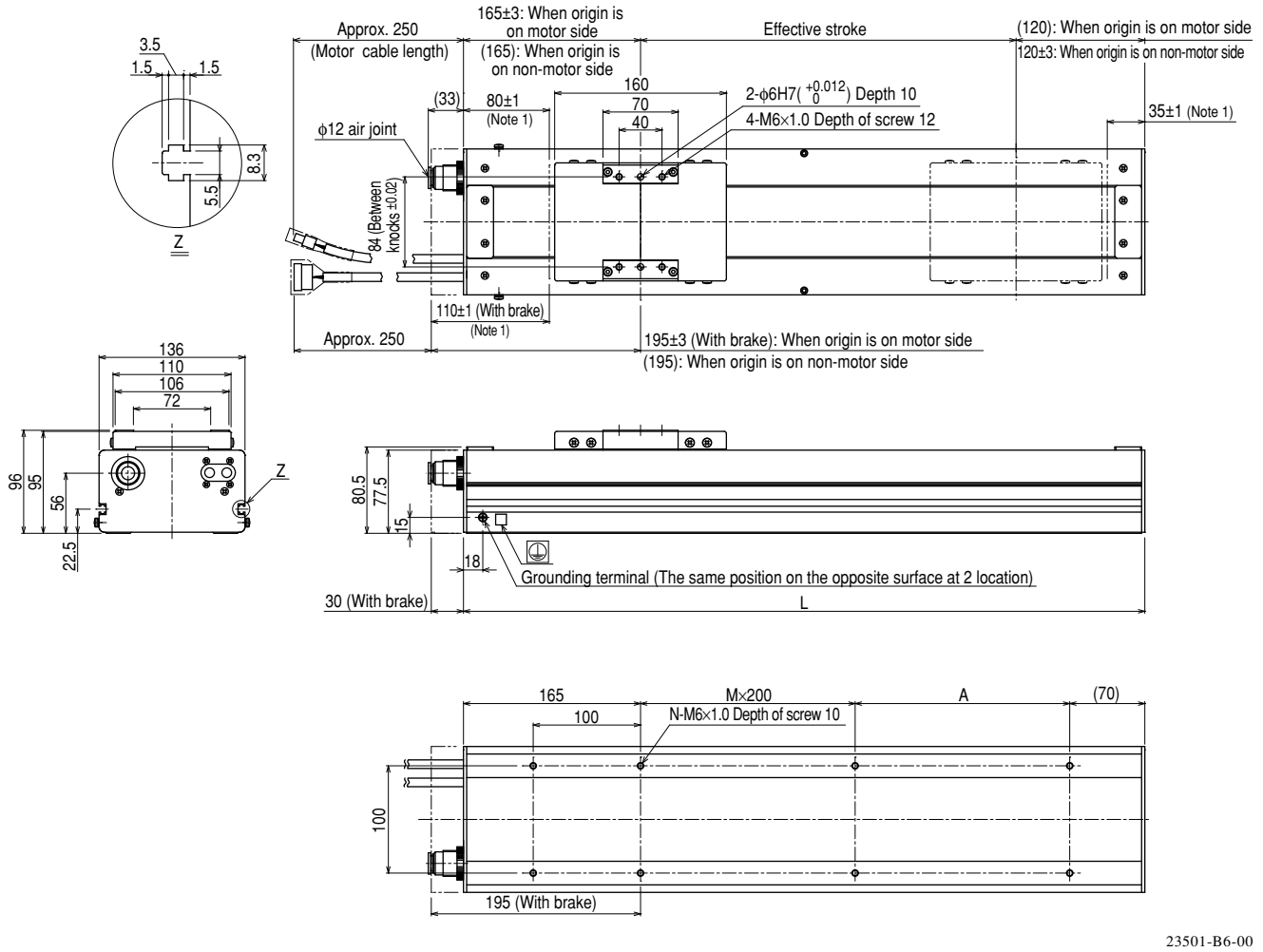
Vertical installation



		A	C
Lead 20	1kg	600	600
	2kg	1200	1200
	4kg	1141	885
Lead 10	4kg	1216	943
	8kg	621	482
	10kg	503	390
Lead 5	10kg	574	445
	15kg	370	287
	20kg	268	208

(Unit: mm)

Dimensions



23501-B6-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R50.
Note 3. Weight of models with no brake. The weight of brake-attached models is 0.4kg heavier than the models with no brake shown in the table.

Effective stroke		150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
L		435	485	535	585	635	685	735	785	835	885	935	985	1035	1085	1135	1185	1235	1285	1335
A		200	50	100	150	200	50	100	150	200	50	100	150	200	50	100	150	200	50	100
M		0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5
N		6	8	8	8	8	10	10	10	10	12	12	12	12	14	14	14	14	16	16
Weight (kg) Note 3		9.2	9.9	10.5	11.2	11.7	12.4	13.0	13.7	14.3	15.0	15.5	16.2	16.8	17.5	18.1	18.8	19.3	20.0	20.6
Maximum speed (mm/sec) Note 4	Lead 20	1000												950	950	750	750	600	600	500
	Lead 10	500												475	475	375	375	300	300	250
	Lead 5	250												237	237	187	187	150	150	125
	Speed setting	–												95%	95%	75%	75%	60%	60%	50%

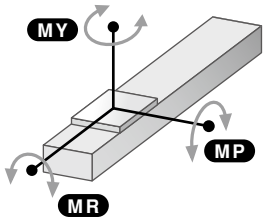
Note 4. When the stroke is longer than 700mm, resonance of the ball screw may occur depending on the operation conditions (critical speed). In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.9 C14H

Specifications

AC servo motor output (W)		200		
Repeatability(mm) Note 1		±0.01		
Position detector		Resolvers Note 2		
Resolution (Pulse/rotation)		16384		
Deceleration mechanism		Ball screw ϕ15 (Class C7)		
Ball screw lead (mm)		20	10	5
Maximum speed (mm/sec) Note 3		1000	500	250
Maximum payload (kg)	Horizontal	40	80	100
	Vertical	8	20	30
Rated thrust (N)		170	341	683
Stroke (mm)		150 to 1050 (50mm pitch)		
Linear guide type		4 rows of circular arc grooves × 2 rail		
Overall length (mm)	Horizontal	Stroke+349		
	Vertical	Stroke+379		
Maximum dimensions of cross section of main unit (mm)		W136×H96		
Cable length (m)		Standard: 3.5 / Option: 5,10		
Controller		SR1-X, TS-X, RCX222, RCX240		
Robot driver		RDX-10		
Degree of cleanliness Note 4		CLASS10		
Intake air (Nℓ/min) Note 5		30 to 90		

Static loading moment



MY	MP	MR
293	294	258

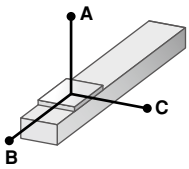
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 700mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. Per 1cf (0.1μm base), when suction blower is used.
Note 5. The necessary intake amount varies depending on the use conditions and environment.

Allowable overhang

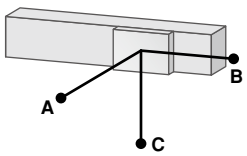
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



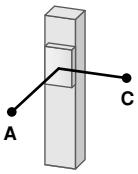
		A	B	C
Lead 20	10kg	2247	1675	958
	20kg	1397	855	528
	40kg	1037	445	318
Lead 10	30kg	1937	583	478
	50kg	1637	364	323
	80kg	1717	242	235
Lead 5	60kg	2443	311	313
	80kg	2193	242	250
	100kg	2000	202	213

Wall installation



		A	B	C
Lead 20	10kg	987	1210	1678
	20kg	497	548	958
	40kg	247	217	598
Lead 10	30kg	402	328	1238
	50kg	227	152	878
	80kg	119	74	678
Lead 5	60kg	197	108	1308
	80kg	127	53	1008
	100kg	85	20	788

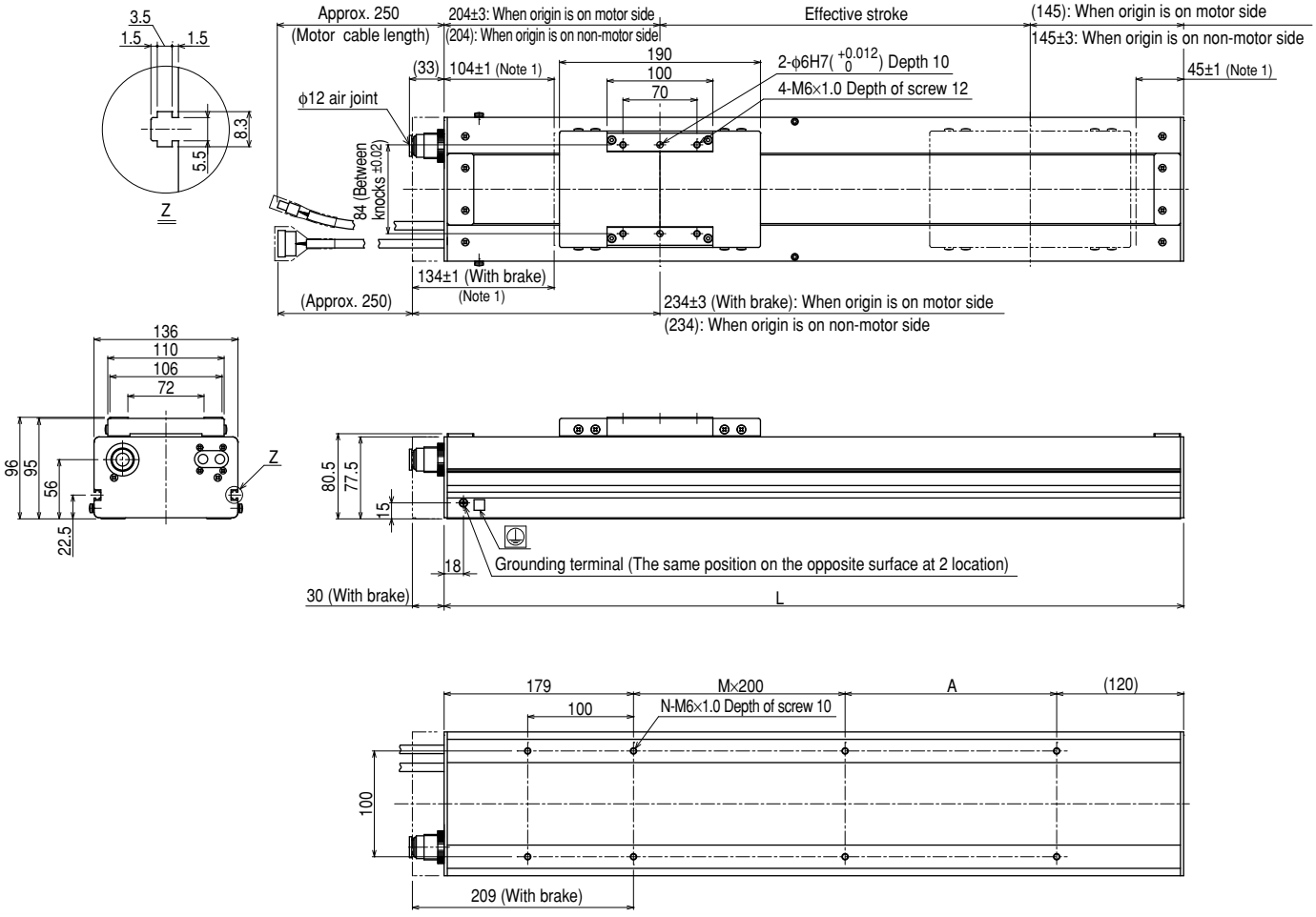
Vertical installation



		A	C
Lead 20	4kg	2400	2008
	6kg	1687	1358
	8kg	1287	1033
Lead 10	10kg	1347	1088
	15kg	887	718
	20kg	657	538
Lead 5	20kg	747	608
	25kg	663	484
	30kg	491	396

(Unit: mm)

Dimensions



23502-B6-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R50.
Note 3. Weight of models with no brake. The weight of brake-attached models is 0.4kg heavier than the models with no brake shown in the table.

Effective stroke		150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050
L		499	549	599	649	699	749	799	849	899	949	999	1049	1099	1149	1199	1249	1299	1349	1399
A		200	50	100	150	200	50	100	150	200	50	100	150	200	50	100	150	200	50	100
M		0	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5
N		6	8	8	8	8	10	10	10	10	12	12	12	12	14	14	14	14	16	16
Weight (kg) Note 3		10.7	11.4	12.0	12.7	13.2	13.9	14.5	15.2	15.8	16.5	17.0	17.7	18.3	19.0	19.6	20.3	20.8	21.5	22.1
Maximum speed (mm/sec) Note 4	Lead 20	1000												950	950	750	750	600	600	500
	Lead 10	500												475	475	375	375	300	300	250
	Lead 5	250												237	237	187	187	150	150	125
	Speed setting	–												95%	95%	75%	75%	60%	60%	50%

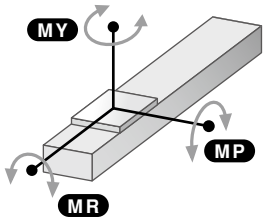
Note 4. When the stroke is longer than 700mm, resonance of the ball screw may occur depending on the operation conditions (critical speed). In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.10 C17

Specifications

AC servo motor output (W)		400	
Repeatability(mm) Note 1		±0.01	
Position detector		Resolvers Note 2	
Resolution (Pulse/rotation)		16384	
Deceleration mechanism		Ball screw ϕ20 (Class C7)	
Ball screw lead (mm)		20	10
Maximum speed (mm/sec) Note 3		1000	500
Maximum payload (kg)	Horizontal	80	120
	Vertical	15	35
Rated thrust (N)		339	678
Stroke (mm)		200 to 1250 (50mm pitch)	
Linear guide type		4 rows of circular arc grooves × 2 rail	
Overall length (mm)	Horizontal	Stroke+395	
	Vertical	Stroke+425	
Maximum dimensions of cross section of main unit (mm)		W168×H114	
Cable length (m)		Standard: 3.5 / Option: 5,10	
Controller		SR1-X, TS-X, RCX222, RCX240	
Robot driver		RDX-20	
Degree of cleanliness Note 4		CLASS10	
Intake air (Nℓ/min) Note 5		30 to 90	

Static loading moment



MY	MP	MR
1032	1034	908

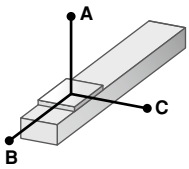
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 900mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. Per 1cf (0.1μm base), when suction blower is used.
Note 5. The necessary intake amount varies depending on the use conditions and environment.

Allowable overhang

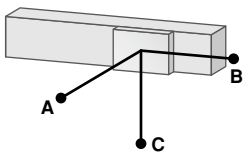
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



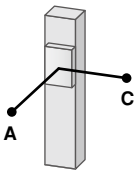
		A	B	C
Lead 20	30kg	2660	871	1040
	50kg	1911	508	615
	80kg	1541	303	377
Lead 10	60kg	2443	418	580
	100kg	2000	237	330
	120kg	1841	192	268

Wall installation



		A	B	C
Lead 20	30kg	1017	789	2576
	50kg	583	426	1808
	80kg	338	221	1380
Lead 10	60kg	525	336	2443
	100kg	271	155	2000
	120kg	207	109	1841

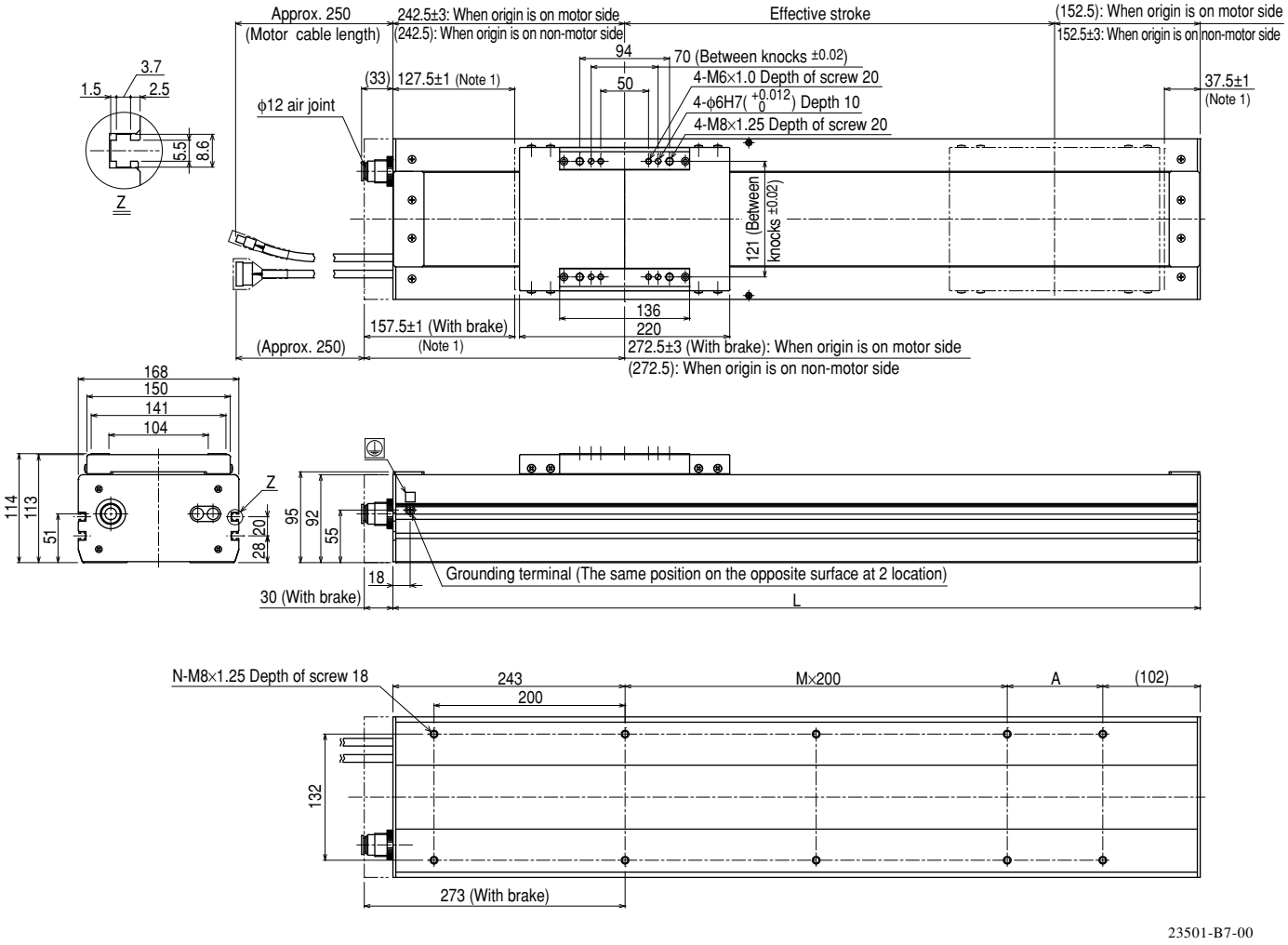
Vertical installation



		A	C
Lead 20	5kg	3000	3000
	10kg	2443	2443
	15kg	1633	1633
Lead 10	15kg	1728	1728
	25kg	1013	1013
	35kg	707	707

(Unit: mm)

■ Dimensions



23501-B7-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R50.
Note 3. Weight of models with no brake. The weight of brake-attached models is 1.5kg heavier than the models with no brake shown in the table.

Effective stroke		200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
L		595	645	695	745	795	845	895	945	995	1045	1095	1145	1195	1245	1295	1345	1395	1445	1495	1545	1595	1645
A		50	100	150	200	50	100	150	200	50	100	150	200	50	100	150	200	50	100	150	200	50	100
M		1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6
N		8	8	8	8	10	10	10	10	12	12	12	12	14	14	14	14	16	16	16	16	18	18
Weight (kg) Note 3		15.0	16.0	17.0	17.9	18.9	19.8	20.8	21.7	22.7	23.6	24.6	25.5	26.5	27.4	28.4	29.3	30.3	31.2	32.2	33.1	34.1	35.0
Maximum speed (mm/sec) Note 4	Lead 20	1000															800	800	700	700	600	600	500
	Lead 10	500															400	400	350	350	300	300	250
	Speed setting	–															80%	80%	70%	70%	60%	60%	50%

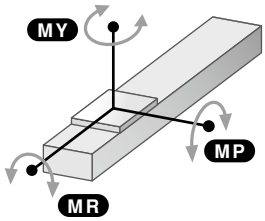
Note 4. When the stroke is longer than 900mm, resonance of the ball screw may occur depending on the operation conditions (critical speed).
In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.11 C17L

Specifications

AC servo motor output (W)		600
Repeatability(mm) Note 1		±0.02
Position detector		Resolvers Note 2
Resolution (Pulse/rotation)		16384
Deceleration mechanism		Ball screw ϕ25 (Class C10)
Ball screw lead (mm)		50
Maximum speed (mm/sec) Note 2		1000
Maximum payload (kg)	Horizontal	50
	Vertical	10
Rated thrust (N)		204
Stroke (mm)		1150 to 2050 (100mm pitch)
Linear guide type		4 rows of circular arc grooves × 2 rail
Overall length (mm)	Horizontal	Stroke+485
	Vertical	Stroke+515
Maximum dimensions of cross section of main unit (mm)		W168×H114
Cable length (m)		Standard: 3.5 / Option: 5,10
Controller		SR1-X, TS-X, RCX222, RCX240
Robot driver		RDX-20
Degree of cleanliness Note 4		CLASS10
Intake air (Nℓ/min) Note 5		30 to 90

Static loading moment



MY	MP	MR
1032	1034	908

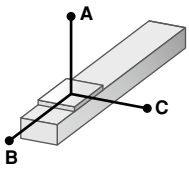
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 1750mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. Per 1cf (0.1μm base), when suction blower is used.
Note 5. The necessary intake amount varies depending on the use conditions and environment.

Allowable overhang

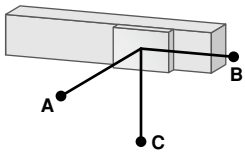
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



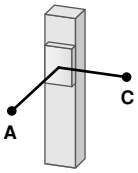
		A	B	C
Lead 50	10kg	4000	2687	3327
	30kg	3045	872	929
	50kg	2602	509	714

Wall installation



		A	B	C
Lead 50	10kg	3436	2605	4000
	30kg	1169	790	3045
	50kg	666	427	2602

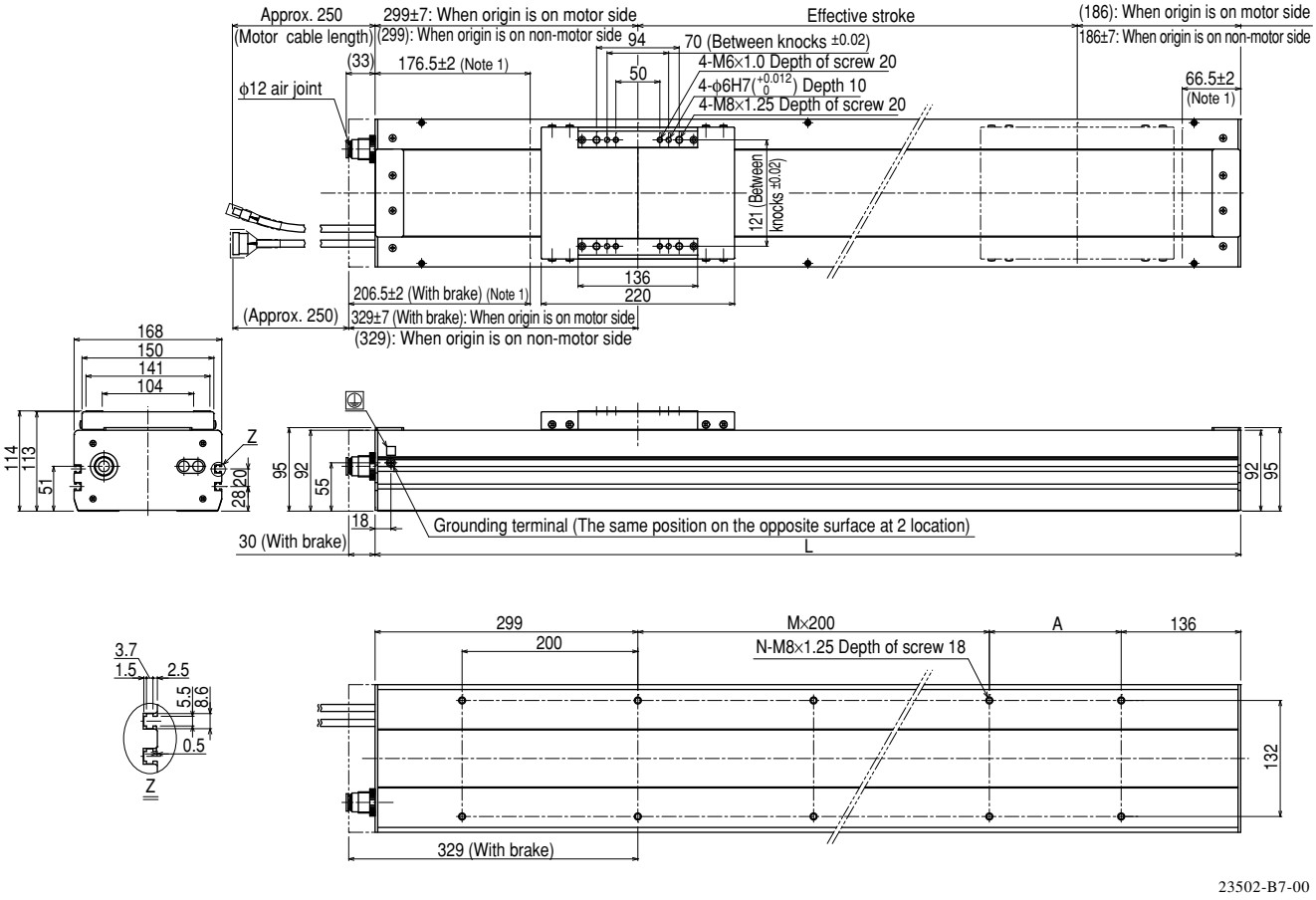
Vertical installation



		A	C
Lead 50	2kg	1200	1200
	5kg	3000	3000
	10kg	2579	2579

(Unit: mm)

Dimensions



23502-B7-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R50.
Note 3. Weight of models with no brake. The weight of brake-attached models is 1.5kg heavier than the models with no brake shown in the table.

Effective stroke		1150	1250	1350	1450	1550	1650	1750	1850	1950	2050
L		1635	1735	1835	1935	2035	2135	2235	2335	2435	2535
A		200	100	200	100	200	100	200	100	200	100
M		5	6	6	7	7	8	8	9	9	10
N		16	18	18	20	20	22	22	24	24	26
Weight (kg) Note 3		39.1	41.2	43.2	45.2	47.3	49.3	51.3	53.4	55.4	57.4
Maximum speed (mm/sec) Note 4	Lead 50	1000							900	800	
	Speed setting	–							90%	80%	

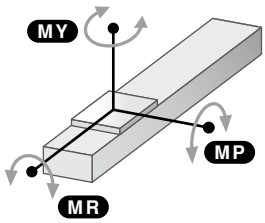
Note 4. When the stroke is longer than 1750mm, resonance of the ball screw may occur depending on the operation conditions (critical speed). In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

1.12 C20

Specifications

AC servo motor output (W)		600	
Repeatability(mm) Note 1		±0.01	
Position detector		Resolvers Note 2	
Resolution (Pulse/rotation)		16384	
Deceleration mechanism		Ball screw ϕ20 (Class C7)	
Ball screw lead (mm)		20	10
Maximum speed (mm/sec) Note 3		1000	500
Maximum payload (kg)	Horizontal	120	–
	Vertical	25	45
Rated thrust (N)		510	1020
Stroke (mm)		200 to 1250 (50mm pitch)	
Linear guide type		4 rows of circular arc grooves × 2 rail	
Overall length (mm)	Horizontal	Stroke+441	
	Vertical	Stroke+471	
Maximum dimensions of cross section of main unit (mm)		W202×H117	
Cable length (m)		Standard: 3.5 / Option: 5,10	
Controller		SR1-X, TS-X, RCX222, RCX240	
Robot driver		RDX-20	
Degree of cleanliness Note 4		CLASS10	
Intake air (Nℓ/min) Note 5		30 to 90	

Static loading moment



MY	MP	MR
1101	1103	968

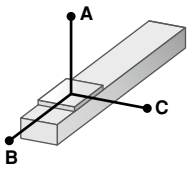
(Unit: N•m)

Note 1. Positioning repeatability in one direction.
Note 2. Position detectors (resolvers) are common to incremental and absolute specifications. If the controller has a backup function then it will be absolute specifications.
Note 3. If the stroke exceeds 900mm, resonance may occur in the ball screw depending on the operation area (critical speed). If this occurs, make the adjustment to decrease the operation speed based on the max. speed stated in the table shown at the lower portion of the drawing.
Note 4. Per 1cf (0.1μm base), when suction blower is used.
Note 5. The necessary intake amount varies depending on the use conditions and environment.

Allowable overhang

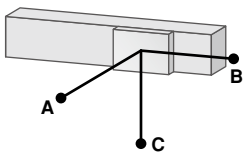
Note. Distance from center of slider top to center of gravity of object being carried at a guide servicelife of 10,000km.
Note. Stroke is 600mm when calculating the service life.

Horizontal installation



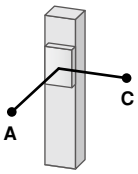
		A	B	C
Lead 20	50kg	2602	869	1145
	80kg	2193	528	720
	120kg	1841	339	505

Wall installation



		A	B	C
Lead 20	50kg	1144	798	2602
	80kg	717	456	2193
	120kg	466	267	1841

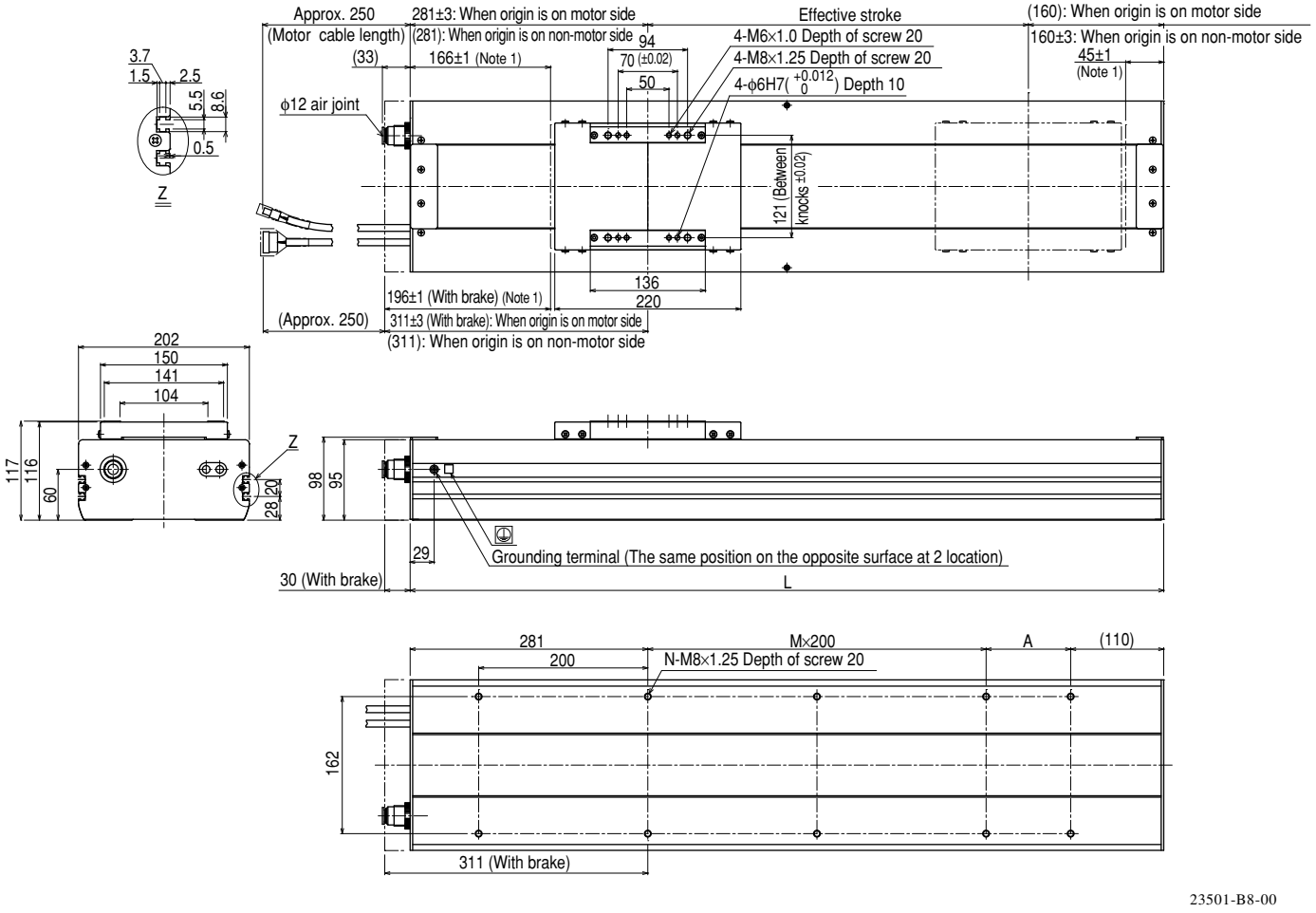
Vertical installation



		A	C
Lead 20	15kg	2711	2711
	20kg	2045	2045
	25kg	1647	1647
Lead 10	20kg	2182	2182
	30kg	1437	1437
	45kg	939	939

(Unit: mm)

■ Dimensions



23501-B8-00

Note 1. Distance from both ends to the mechanical stopper.
Note 2. Minimum bend radius of motor cable is R50.
Note 3. Weight of models with no brake. The weight of brake-attached models is 2.0kg heavier than the models with no brake shown in the table.

Effective stroke		200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250
L		641	691	741	791	841	891	941	991	1041	1091	1141	1191	1241	1291	1341	1391	1441	1491	1541	1591	1641	1691
A		50	100	150	200	50	100	150	200	50	100	150	200	50	100	150	200	50	100	150	200	50	100
M		1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	5	5	5	6	6
N		8	8	8	8	10	10	10	10	12	12	12	12	14	14	14	14	16	16	16	16	18	18
Weight (kg) Note 3		25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	43.0	44.0	45.0	46.0
Maximum speed (mm/sec) Note 4	Lead 20	1000															800	800	700	700	600	600	500
	Lead 10	500															400	400	350	350	300	300	250
	Speed setting	–															80%	80%	70%	70%	60%	60%	50%

Note 4. When the stroke is longer than 900mm, resonance of the ball screw may occur depending on the operation conditions (critical speed).
In this case, reduce the speed setting on the program by referring to the maximum speeds shown in the table above.

Chapter 6 Appendix

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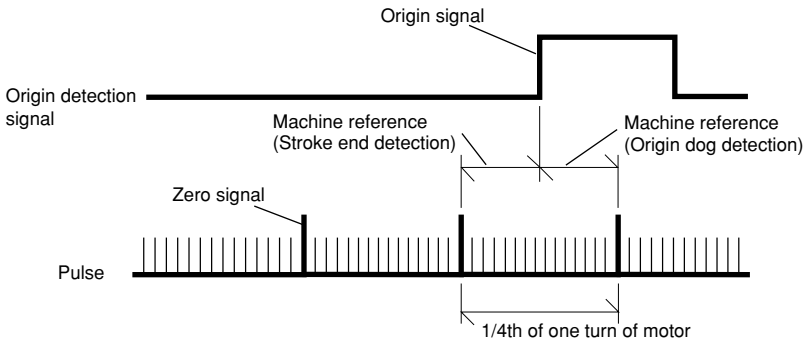
1. About machine reference

The position detector built into the motor issues a "0" pulse each time the motor rotates 1/4th of one turn. When return-to-origin is performed, a difference in distance occurs between the position where the origin signal is detected and the point at which the next "0" pulse is received. This is called the machine reference and is usually expressed as a percent, with 100% being equal to 1/4th of one turn of the motor. The machine reference value must be within the allowable range (25 to 75%) to maintain axis movement repeatability.
To check the machine reference value, an optional programming box (HPB or RPB)/handy terminal is needed. The machine reference value is displayed on the LCD screen of the programming box/handy terminal when return-to-origin is complete. (See the figure below.)

NOTE

When you select an absolute type position detector, you do not need to perform the return-to-origin each time the robot controller is turned on and readjust the machine reference value. If for some reason the machine reference adjustment becomes necessary, please contact your distributor.

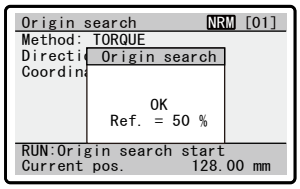
Machine reference



23001-B0-00

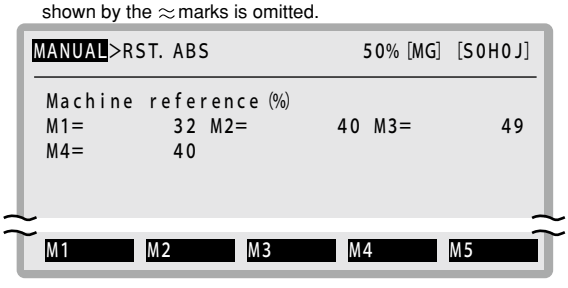
Machine reference value display examples

SR1



TS-X

* In the screen illustration below, a section of the screen shown by the ≈ marks is omitted.



RCX Series

23002-B0-00

2. Equation of moment of inertia calculation

CAUTION

The robot must be operated with correct tolerable moment of inertia and acceleration coefficients according to the manipulator tip mass and moment of inertia.
If this is not observed, premature end to the life of the drive units, damage to the robot parts or residual vibration during positioning may result.

Usually the R axis load is not a simple form, and the calculation of the moment of inertia is not easy.
As a method, the load is replaced with several factors that resemble a simple form for which the moment of inertia can be calculated. The total of the moment of inertia for these factors is then obtained.
The objects and equations often used for the calculation of the moment of inertia are shown below.

1. Moment of inertia for cylinder

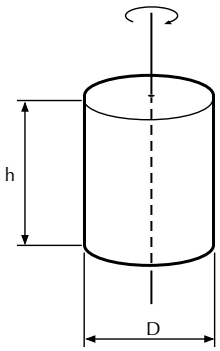
The moment of inertia (J) for a cylinder having a rotation center such as shown below is given by

Moment of inertia for cylinder

$$J = \frac{\rho\pi D^4 h}{32g} = \frac{WD^2}{8g} \quad (kgfcmsec^2)$$

$$= \frac{mD^2}{8} \quad (kgm^2)$$

ρ : Density (kg/cm³)
g : Gravitational acceleration (cm/sec²)
W : Weight of cylinder (kgf)
m : Mass of cylinder (kg)



23003-B0-00

2. Moment of inertia for rectangular parallelepiped

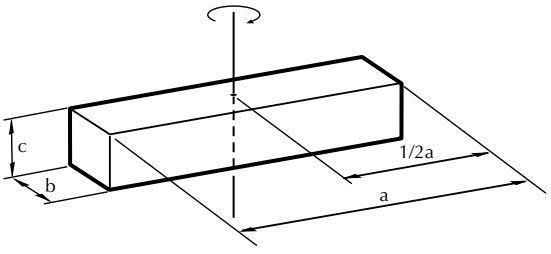
The moment of inertia (J) for a rectangular parallelopiped having a rotation center as shown below is given by

Moment of inertia for rectangular parallelepiped

$$J = \frac{\rho abc\,(a^2 + b^2)}{12g} = \frac{W\,(a^2 + b^2)}{12g} \quad (kgfcmsec^2)$$

$$= \frac{m\,(a^2 + b^2)}{12} \quad (kgm^2)$$

ρ : Density (kg/cm³)
g : Gravitational acceleration (cm/sec²)
W : Weight of cylinder (kgf)
m : Mass of cylinder (kg)



23004-B0-00

3. When the object's center line is offset from the rotation center.

The moment of inertia (J) when the center of the cylinder is offset by a distance "x" from the rotation center as shown below is given by

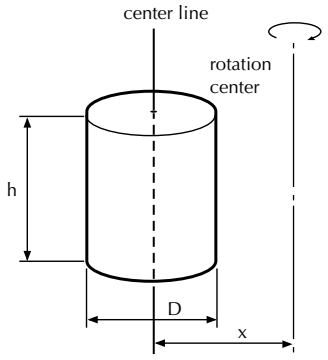
When the object's center line is offset from the rotation center (cylindrical column)

$$J = \frac{\rho\pi D^4 h}{32g} + \frac{\rho\pi D^2 hx^2}{4g}$$

$$= \frac{WD^2}{8g} + \frac{Wx^2}{g} \ (kgfcmsec^2)$$

$$= \frac{mD^2}{8} + mx^2 \ (kgm^2)$$

W : Weight of cylinder (kgf)
m : Mass of cylinder (kg)
e : Density (kg/cm³)
g : Gravitational acceleration (cm/sec²)



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In the same manner, the moment of inertia (J) of a prism as shown below is given by

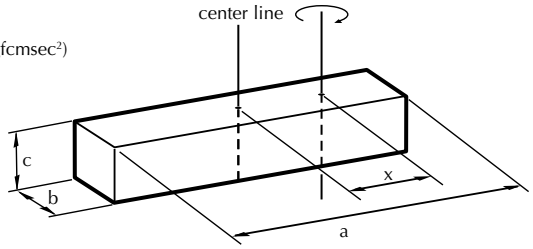
When the object's center line is offset from the rotation center (square column)

$$J = \frac{\rho abc\,(a^2 + b^2)}{12g} + \frac{\rho abcx^2}{g}$$

$$= \frac{W\,(a^2 + b^2)}{12g} + \frac{Wx^2}{g} \ (kgfcmsec^2)$$

$$= \frac{m\,(a^2 + b^2)}{12} + mx^2 \ (kgm^2)$$

W : Weight of prism (kgf)
m : Mass of prism (kg)



23006-B0-00

Revision record

Manual version	Issue date	Description
Ver. 1.00	May 2012	First edition
Ver. 1.01	Jul. 2012	Cable specifications for ERCD were changed, some misprints were corrected, etc.

Installation Manual

Single-axis Robots

FLIP-XC Series

Clean type

Jul. 2012
Ver. 1.01
This manual is based on Ver. 1.01 of Japanese manual.

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